Research Product 91-15

Battlefield Maintenance Case Study: Task Commonality Analysis for System Maintenance Requirements

June 1991

Fort Gordon Field Unit
Systems Research Laboratory

U.S. Army Research Institute for the Behavioral and Social Sciences

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UNCLASSIFIED

CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

RT SECURITY CLASSIFICATION ssified	1b. RESTRICTIVE MARKINGS --
RITY CLASSIFICATION AUTHORITY ASSIFICATION / DOWNGRADING SCHEDULE	3. DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.
RMING ORGANIZATION REPORT NUMBER(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S) ARI Research Product 91-15
E OF PERFORMING ORGANIZATION Associates, Inc. 6b. OFFICE SYMBOL (If applicable) --	7a. NAME OF MONITORING ORGANIZATION U.S. Army Research Institute
RESS (City, State, and ZIP Code) Sixteenth Street, Suite 400 r Spring, MD 20910	7b. ADDRESS (City, State, and ZIP Code) Fort Gordon Field Unit Fort Gordon, GA 30905-5230
IE OF FUNDING / SPONSORING ANIZATION U.S. Army Research .tute for the Behavioral iocial Sciences 8b. OFFICE SYMBOL (If applicable) PERI-S	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER DAHC35-89-D-0028, D.O. 0003
RESS (City, State, and ZIP Code) Eisenhower Avenue indria, VA 22333-5600	10. SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.
63007A	793	3.6.(3)	C01

E (Include Security Classification)
Lefield Maintenance Case Study: Task Commonality Analysis for System Maintenance irements

SONAL AUTHOR(S)
ht, Daniel; and Enwright, Jason

PE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
rim	FROM 90/07 TO 90/09	1991, June	

PLEMENTARY NOTATION

COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
LD	GROUP	SUB-GROUP	Airland Battle Future (ALB-F), Doctrine Battlefield Maintenance System (BMS) ~~Doctrine~~ (Continued)

TRACT (Continue on reverse if necessary and identify by block number)

In June 1990, the U.S. Army Ordnance Center and School requested that the U.S. Army arch Institute for the Behavioral and Social Sciences (ARI) examine the Battle Mainte-e System to determine whether the current automotive maintenance system and military pational specialties (MOS) need to be restructured. The methods documented in this arch product provide a procedural baseline from which to assess MOS restructuring irements based on the comparison of system maintenance tasks requirements. This arch product can be used by Army proponent branches to assess the need for MOS ructuring or merger actions.

TRIBUTION / AVAILABILITY OF ABSTRACT NCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION Unclassified
ME OF RESPONSIBLE INDIVIDUAL orothy L. Finley	22b. TELEPHONE (Include Area Code) (404) 791-5523 22c. OFFICE SYMBOL PERI-IG

m 1473, JUN 86 Previous editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE
UNCLASSIFIED

ARI Research Product 91-15

18. SUBJECT TERMS (Continued)

Task Comparability Analysis (TCA), for Systems Maintenance Requirements Model
Military Occupational Specialty (MOS) restructuring

Research Product 91-15

Battlefield Maintenance Case Study: Task Commonality Analysis for System Maintenance Requirements

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June 1991

Army Project Number
2Q263007A793

Human Factors in Training and
Operational Effectiveness

FOREWORD

Decisions made regarding Military Occupational Specialty (MOS) structures with respect to what set of tasks a MOS is to perform determine soldier performance effectiveness, initial and sustainment training costs, MOS supportability, and personnel system management capability. This effort was performed as part of the research program, Soldier-Equipment Considerations in MOS Design, to develop methods to perform manpower, personnel, and training analyses to enhance the likelihood of optimal MOS structuring decisions.

The Battlefield Maintenance System (BMS) includes several new maintenance concepts needed to support the Airland Battle-Future. One of the concepts is that of consolidating current ordnance maintenance MOS to reduce the number of MOS implementing the BMS. This research was performed with the support of the U.S. Army Ordnance Center and School (USAOCS) to develop an initial front-end analysis method for identifying potential MOS consolidation opportunities. The results were development of the Task Commonality Analysis Method (TCAM) and the findings resulting from the application of TCAM to a small subset of ordnance MOS and equipment.

The results were briefed to the USAOCS in September 1990 and to Combined Arms Support Command in October 1990. USAOCS has subsequently briefed the results to other parties and intends to apply the TCAM to most, if not all, ordnance MOS and equipment.

EDGAR M. JOHNSON
Technical Director

BATTLEFIELD MAINTENANCE SYSTEM CASE STUDY: TASK COMMONALITY ANALYSIS FOR SYSTEM MAINTENANCE REQUIREMENTS

EXECUTIVE SUMMARY

Requirement:

The U.S. Army Ordnance Center and School (USAOCS) is engaged in developing and fielding new maintenance doctrine. This new doctrine is designed to support the U.S. Army's Airland Battle-Future (ALB-F) doctrine, which prescribes how the Army will fight in future battles.

The Army's current field maintenance system is not well suited to support this new doctrine. The current system has five maintenance levels: Operator and Crew (O&C), Organizational (ORG), Direct Support (DS), General Support (GS), and Depot. To provide the forward maintenance support required by the ALB-F concept, USAOCS has developed the Battlefield Maintenance System (BMS). BMS will use a four-level system that combines what was formerly organizational and direct support maintenance into a single function. BMS is designed to provide a greater capability to rapidly repair and return equipment to the battle.

In June 1990, USAOCS requested the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) examine BMS for developing possible military occupational specialty (MOS) restructuring issues surrounding the implementation of BMS into the Ordnance force structure. ARI agreed to undertake this examination in the form of a case study and to document its methodology for future use by USAOCS and other Army branches. This study was performed from July through September 1990.

Procedure:

The work underlying this effort involved three steps. First, Ordnance doctrine, maintenance data, and MOS data were gathered and reviewed. Next, a case study approach was developed that included the identification of data requirements, development of a Task Commonality Analysis Model (TCAM), and development of the data base needed to support application of the model. Finally, TCAM was applied to BMS maintenance data and the results, conclusions, and recommendations were documented. In the time frame during which this analysis was completed, the M1, Abrams Main Battle Tank and the M88, Track Recovery Vehicle, were the focus of the effort.

Findings:

There are five primary findings concerning MOS restructuring based on the BMS doctrine:

1. MOS 63G and 63J should not be considered for any further study in terms of possible merger with other track automotive MOS.

2. A preliminary review of two subassemblies common to the M2, M3, M88, and M113 indicates a high level of functional comparability between systems. Based on this, analysis of the maintenance tasks for all these vehicles should be strongly considered.

3. O&C maintenance tasks should be considered in any restructuring of MOS performing maintenance on the M88 as operator and crew maintenance is performed by MOS 63E, 63H, 63N, and 63T. These MOS are also the primary maintainers of the system at the field repair (FR) level of maintenance.

4. O&C maintenance requirements should be considered significant factors in possible restructuring decisions for MOS performing maintenance on the M1 tank because a large number of tasks will be moved from the ORG maintenance level to the O&C level of maintenance as a result of BMS.

5. Based on the significance of combining component replacement and component repair tasks at the same maintenance level, all track automotive systems and MOS should be analyzed to determine the effects on these systems of the merger of ORG and DS maintenance.

The methods documented in this research product provide a procedural baseline with which to assess further the MOS restructuring requirements based on the comparison of system maintenance task requirements.

Utilization of Findings:

USAOCS can use the analytical results to make initial decisions to proceed with MOS restructuring and to identify areas requiring further, more detailed investigation into MOS requirements associated with BMS. Furthermore, TCAM can be utilized by USAOCS and other Army proponent branches as a method with which to assess the need for MOS restructuring or merger actions based on the functional commonality of equipment systems and the commonality of tasks required to maintain the equipment systems.

BATTLEFIELD MAINTENANCE SYSTEM CASE STUDY: TASK COMMONALITY ANALYSIS FOR SYSTEM MAINTENANCE REQUIREMENTS

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BATTLEFIELD MAINTENANCE SYSTEM CASE STUDY: TASKS COMMONALITY ANALYSIS FOR SYSTEM MAINTENANCE REQUIREMENTS

Introduction

The U.S. Army's Airland Battle Future (ALB-F) doctrine prescribes how the Army will fight in future battles. The future, non-linear warfighting scenario in Central Europe will be characterized by close, deep, and rear operations occurring simultaneously. The ALB-F doctrine calls for greater maneuver force agility and flexibility in response to the new tactical environment. In response to the new demands of force sustainment imposed by this doctrine, the U.S. Army Ordnance Center and School (USAOCS) is formulating the concept of the Battlefield Maintenance System (BMS). Its primary goal is to facilitate extended mobile operations by providing maintenance support as far forward as possible.

In addressing the impacts of BMS, a major concern for USAOCS is whether the existing automotive maintenance career management field, the 63 CMF, will need to be restructured and its military occupational specialties (MOS) consolidated. This research product has been prepared to provide initial answers to these CMF and MOS questions as well as to provide an analytical method that can be used to study these issues further.

<u>Background</u>

The Army's current field maintenance system is not well suited to support the new BMS doctrine. The current system utilizes five maintenance levels: Operator and Crew (O&C), Organizational (ORG), Direct Support (DS), General Support (GS), and Depot. In the present system, equipment operators and crew are responsible for very limited diagnostics and repairs, minor adjustments, and preventive maintenance. Other maintenance activities occur away from the battlefield.

To provide the forward maintenance support required by the ALB-F concept, BMS will use a four level system that combines what was formerly organizational and direct support maintenance into a single function assigned to a maintenance unit within the forward support battalion. BMS is designed to provide a greater capability to rapidly repair and return equipment to the battle. BMS is also designed to decrease repair times, increase responsiveness, and increase war fighting ability by implementing the repair forward concept.

The merging of ORG and DS maintenance into a single level of maintenance, Field Repair (FR), will have significant impacts on existing maintenance practices. These include:

1. An increased number of system tasks performed in locations that are closer to the battlefield.

2. Changes in the nature of the tasks performed in these forward locations in terms of their complexity, skill requirements, performance levels, and tool requirements.

3. Less effective automotive MOSs as currently structured from the aspects of both CMF requirements and individual MOS task aggregation requirements.

In light of this new doctrine and potential impacts, the Ordnance Corps is faced with critical decisions regarding the need for restructuring MOSs within the Ordnance CMF. Will BMS require the revision of CMF and MOS structures either by eliminating tasks, adding tasks, merging tasks with other MOSs, or requiring new tasks leading to new MOSs?

Failing to properly address the effects of BMS on the affected CMFs and MOSs will seriously undermine the Ordnance Corp's ability to provide adequate maintenance capability and capacity in terms of maintainer skills and abilities.

BMS Case Study Goals

The principal goal of this case study is to determine whether USAOCS must consider restructuring the 63 CMF and consolidating its MOSs. Three fundamental issues must be addressed:

1. How will current maintenance functions be changed as a result of the merger of organizational and direct support maintenance?

2. What soldier requirement changes will result from the redistribution of maintenance tasks due to the introduction of BMS?

3. What MOS structure would best support these maintenance task requirements?

In addition to addressing these issues, this case study has also included the development of a methodology, the Task Commonality Analysis Model (TCAM), which has been used for developing objective data supporting the BMS MOS restructuring assessment decision. TCAM has been designed to:

1. Identify the system driven maintenance tasks at the new Field Repair maintenance level; and

2. Provide for development of recommendations for candidate MOS restructuring analysis.

The method may be used for further analysis of BMS issues as well as MOS restructuring assessment decisions stemming from other Army initiatives.

Organization of the Research Product

This research product is organized into three sections. The first section describes the analytical approach and the application of TCAM to the BMS scenario. Included in this section are the rationale for the method, a description of data requirements, data collection procedures used for collecting and developing the data, and data management techniques required to answer the BMS questions.

The second section presents the findings generated by the application of the methodology to the BMS scenario. These findings address the need for 63 CMF restructuring and are presented with respect to the three underlying issues.

The third section presents conclusions with respect to the need for USAOCS to consider restructuring the 63 CMF and MOSs. Additionally, task and training tradeoff issues requiring analysis are identified.

Appendixes provide descriptions of TCAM as well as supporting data used in its application and the analysis of BMS implications for CMF restructuring analysis.

BMS Case Study Methodology

The question of the BMS case study is: Will the implementation of BMS create a need for Ordnance Corps MOS restructuring? The answer to this question is dependent upon addressing these issues:

1. How will current maintenance functions be changed as a result of the merger of ORG and DS maintenance?

2. What soldier requirement changes will result from the redistribution of maintenance tasks due to the introduction of BMS?

3. What MOS structure would best support these maintenance task requirements?

This section presents the methods used to perform the case study and the rationale for those methods. They are based on the TCAM model described in Appendix A. First, an overview of the analytical process is presented. Second, the data base development and data collection procedures are detailed. The last section presents the data analyses and the process of assigning enabling criteria to tasks.

Overview of the Analytical Process

Much of the answer to the three issues is grounded in an understanding of the similarities and differences between maintenance tasks to be performed under BMS. If the consolidation of ORG and DS maintenance under BMS results in two or more MOSs performing similar tasks, then a merger action for these MOSs should be considered. Therefore, the focus of the analysis was on task similarities and differences, or task commonality.

Two major variables were chosen to describe task commonality: equipment task requirements and the enabling criteria required to perform those tasks.

The analysis was performed from the perspective of the equipment maintenance requirements imposed by BMS and the soldier requirements imposed by the equipment. Maintenance tasks were described in terms of their equipment and soldier requirements under BMS. The key to the reliability of the results was the derivation of the data and its analysis in the context of what is required by BMS.

Figure 1 presents an overview of the BMS case study data collection and analysis process. Based on TCAM, this process was

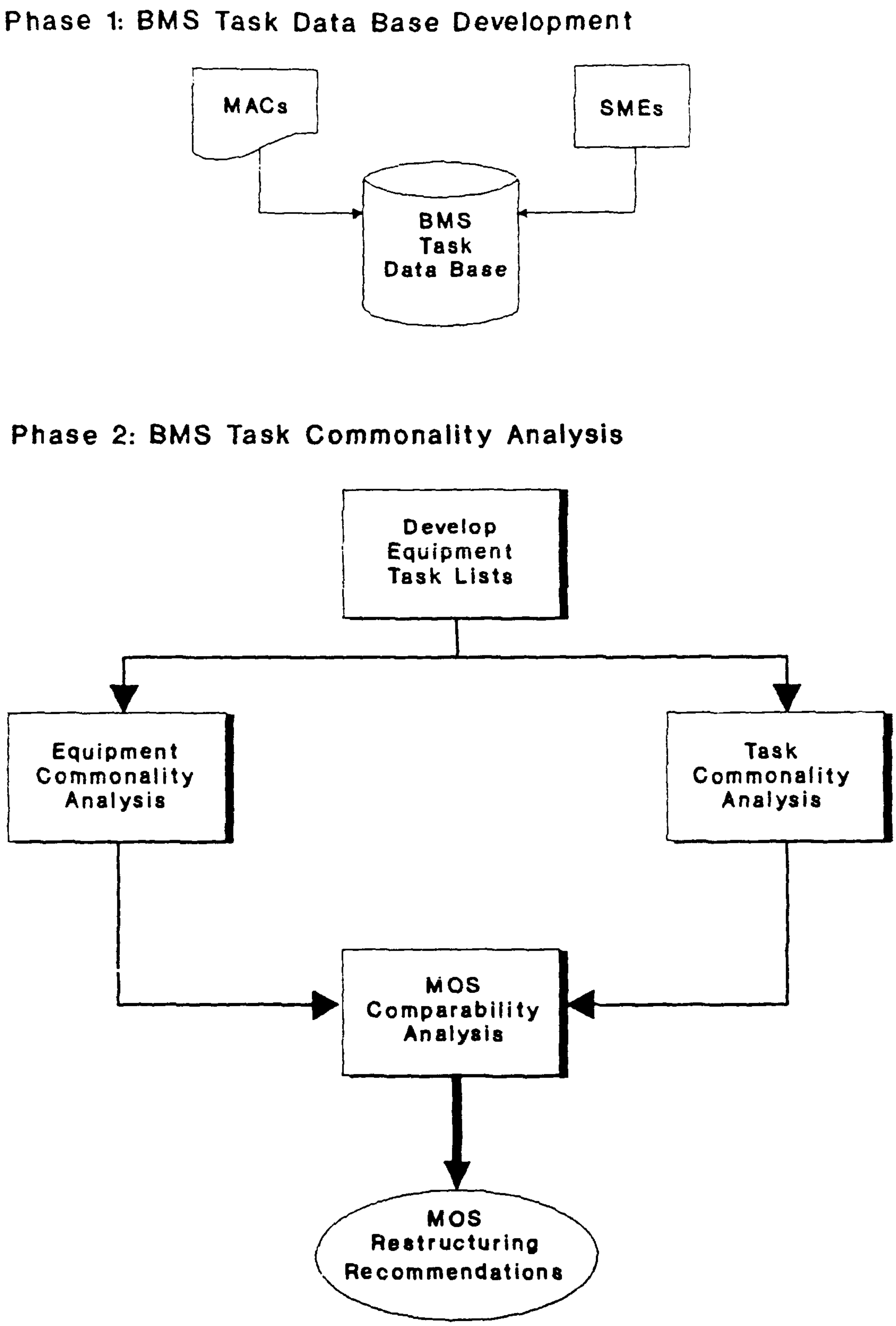

Figure 1. Overview of the BMS case study analysis process.

designed to address each of the study issues. The two phases of analysis were task data base development and task commonality analysis.

Task data base development. A data base was created to reflect equipment system maintenance task requirements and their general knowledge requirements in the context of BMS. The data base was used to manipulate BMS task data in the task commonality analysis phase of the study. The list of maintenance tasks to be performed was built from current Army maintenance documents. Subject matter experts (SMEs) verified task selection. Measures of the general knowledge requirements of these tasks, enabling criteria, were assigned to tasks by SMEs using the process described in Appendix A.

Task commonality analysis. The first part of the analysis built BMS task lists for Unit (formerly operator and crew) and Field Repair levels of maintenance. The second part of the analysis compared tasks both within and between equipment systems to describe how BMS will affect soldier requirements. The last analysis used the outputs of the first two to recommend MOS structures and identify tradeoff issues based on the identified commonalities.

Phase One: Task Data Base Development

A data base was developed to accept three specific elements of M1 and M88 task data. The data elements included: (1) system maintenance tasks, (2) the enabling criteria required to perform the tasks, and (3) the MOS(s) currently responsible for performing the tasks.

The equipment subassembly level of task data detail was chosen as the focus of the analysis. The primary reason was that these tasks reflect the effects of the implementation of BMS in maintenance tasks. A lesser level of detail, such as the system level, might not show important changes in job requirements resulting from BMS. Findings derived from task steps of performance yield more detailed information than is necessary to answer the primary study question. Task data at the subassembly level of detail are readily available and detailed enough to allow meaningful comparisons between equipment systems.

Data requirements. A wide variety of documents, provided by the Ordnance School, was reviewed in the initial stages of the case study. These are presented in the References. The Draft Training and Doctrine Command (TRADOC) Pamphlet 525-XX, U.S. Army Operational Concept for The Battlefield Maintenance System (BMS), July 1990, provided the mission context in which the study data were developed.

The case study analysis was based on maintenance data from the M1 and M88 equipment systems. The scope of the analysis was limited to three specific data items: equipment at the subsystem (or subassembly) level, enabling criteria, and MOSs performing tasks.

This focus resulted in primary reliance on equipment system maintenance allocation charts (MACs) and programs of instruction (POI) related to the maintainers of those equipment systems. Equipment maintenance tasks were derived from the MACs. These tasks were inclusive of all tasks performed on the M1 and M88 at ORG and DS levels of maintenance.

Ordnance maintenance MOS POIs were audited to determine what general enabling criteria were required in performance of maintenance tasks. The POIs used for developing the enabling criteria spanned many types of maintenance training to ensure the adequacy of the criteria. The POIs ranged from training on maintaining tracked and wheeled automotive systems to training on fuel and electrical systems.

Building the data base. A data base was developed to process large quantities of task data. The data base was structured to provide flexible query capability allowing data to be grouped and sorted on task variables of equipment and enabling criteria requirements or combinations of these variables. This was accomplished in part by the development of a task numbering scheme that allowed the organization of tasks within equipment systems by major assemblies and subassemblies. The capability to group tasks by maintenance functions was provided by a field in the data base for task action verbs in the MACs, such as "Inspect" and "Repair". A sample of the data base structure is presented in Figure 2. Additional fields were added to track current MOSs against BMS maintenance task requirements.

Data collection procedure. The actual collection and processing of data consisted of several interdependent steps designed to optimize the use of SMEs by deriving as much data as possible from available written sources and verifying those data with SMEs. This procedure precluded the considerable time otherwise required for a SME panel to generate all of the data.

Developing task lists. Lists of tasks representing the M1 and M88 maintenance requirements were derived from their respective MACs and entered into the data base. All tasks associated with an equipment system and identified in the MACs were included in these lists.

Identifying sustainment tasks. The scope of the analysis was limited to those tasks considered essential for equipment system sustainment under the BMS scenario. Examining all M1 and M88 tasks would be difficult and the results would not

record#	system	maintlvl	assy	subassy	actverb	descrip	e	g	b	c1	c2	c3	c4	c5
1	M1	C	10	0	INSPECT	POWERPACK ASSEMBLY	X			1	3	10	11	12
3	M1	C	10	0	TEST	POWERPACK ASSEMBLY	X			1	4	10	11	12
4	M1	C	10	0	SERVICE	POWERPACK ASSEMBLY	X			1	3	4	8	9
5	M1	F	10	0	REMOVE	POWERPACK ASSEMBLY	X			1	4	8	12	18
6	M1	F	10	0	INSTALL	POWERPACK ASSEMBLY	X			1	4	8	12	18
7	M1	F	10	0	REPLACE	POWERPACK ASSEMBLY	X			3	4	8	12	0
8	M1	F	10	0	REPAIR	POWERPACK ASSEMBLY	X		X	3	4	6	8	17
10	M1	C	10	10	INSPECT	ENGINE ASSEMBLY	X		X	3	4	10	11	12
11	M1	C	10	10	ADJUST	ENGINE ASSEMBLY			X	1	4	9	11	12
12	M1	F	10	10	REPLACE	ENGINE ASSEMBLY			X	4	7	8	18	24
13	M1	F	10	10	REPAIR	ENGINE ASSEMBLY	X		X	3	4	6	8	18
14	M1	F	10	10	REPAIR	COUPLING CLAMP	X			17	18	25	0	0
16	M1	F	10	11	REPLACE	FORWARD ENGINE MODULE			X	1	3	4	8	18
17	M1	F	10	11	REPAIR	FORWARD ENGINE MODULE	X			1	4	7	8	23
18	M1	C	10	11	REPLACE	GAS COVER AND COMBUSTER ASSEMBLY SPARK IGNITER	X			4	8	25	0	0
19	M1	F	10	11	REPAIR	GAS COVER AND COMBUSTER ASSEMBLY SPARK IGNITER			X	8	25	27	29	0
20	M1	C	10	11	INSPECT	COMBUSTOR LINER	X			4	8	25	0	0
21	M1	F	10	11	REPLACE	COMBUSTOR LINER	X			4	8	25	0	0
22	M1	F	10	11	REPLACE	IGV AND BLEED ACTUATOR	X			4	8	25	29	0
23	M1	F	10	11	ADJUST	IGV AND BLEED ACTUATOR	X			4	25	29	0	0
24	M1	C	10	11	REPLACE	ACCESSORY GEARBOX DRIVE ASSEMBLY	X			1	3	4	8	25
25	M1	F	10	11	REPLACE	AIR-BLEED BUTTERFLY VALVE	X			4	8	0	0	0
26	M1	F	10	11	REPLACE	METAL GRILLE	X			4	25	0	0	0
27	M1	C	10	11	INSPECT	LP ROTOR AND HOUSING ASSY			X	1	3	7	8	13
29	M1	C	10	12	REPLACE	TURBINE EXHAUST DUCT	X			8	25	0	0	0
30	M1	F	10	12	REPAIR	TURBINE EXHAUST DUCT	X			8	25	0	0	0
32	M1	C	10	13	REPLACE	REAR ENGINE MODULE			X	8	18	25	0	0
33	M1	F	10	13	REPAIR	REAR ENGINE MODULE			X	4	8	18	25	29
34	M1	F	10	13	REPLACE	REAR ENGINE SUBASSEMBLY			X	8	18	25	0	0
35	M1	F	10	13	REPAIR	REAR ENGINE SUBASSEMBLY			X	4	8	25	0	0
36	M1	C	10	13	REPLACE	REDUCTION GEARBOX			X	8	18	25	0	0
37	M1	F	10	13	REPAIR	REDUCTION GEARBOX			X	4	8	8	25	29
39	M1	F	10	14	REPLACE	ACCESSORY GEARBOX DRIVE ASSY			X	1	3	7	8	18
40	M1	C	10	14	REPLACE	GEAR COVER ASSEMBLY			X	1	8	25	0	0
41	M1	F	10	14	REPAIR	GEAR COVER ASSEMBLY			X	8	25	29	0	0
42	M1	C	10	14	REPLACE	OIL RETAINER			X	8	25	0	0	0
43	M1	C	10	14	REPAIR	OIL RETAINER			X	3	8	25	29	0
47	M1	C	10	21	SERVICE	MAIN FUEL CONTROL	X			3	8	20	24	25
48	M1	C	10	21	REPLACE	MAIN FUEL CONTROL		X		3	8	29	0	0
49	M1	F	10	21	REPAIR	MAIN FUEL CONTROL		X		4	8	9	20	25
50	M1	C	10	21	SERVICE	FUEL INJECTION NOZZLE (1 AND 2 PIECE)		X		3	8	24	25	29
51	M1	F	10	21	REPLACE	FUEL INJECTION NOZZLE (1 AND 2 PIECE)		X		3	8	29	0	0
52	M1	F	10	21	REPLACE	PTS FE CONTROL ASSEMBLY		X		3	4	8	9	29
53	M1	C	10	21	REPAIR	PTS FE CONTROL ASSEMBLY		X		3	9	25	29	0
54	M1	F	10	21	REPLACE	IGV FE CONTROL ASSEMBLY		X		3	4	8	9	29
55	M1	F	10	21	REPAIR	IGV FE CONTROL ASSEMBLY		X		3	9	25	29	0
57	M1		10	22	REPLACE	PUMP AND MANIFOLD ASSEMBLY		X		8	9	12	29	0
58	M1	F	10	22	REPAIR	PUMP AND MANIFOLD ASSEMBLY		X		3	4	12	20	21
59	M1		10	22	REPLACE	IN-TANK ELECTRICAL FUEL PUMP (LEFT OR RIGHT HAND)		X		4	8	9	12	29
62	M1		10	24	INSPECT	TUBEAXIAL/MIXED FLOW FAN	X			1	13	23	0	0
63	M1		10	24	REPLACE	TUBEAXIAL/MIXED FLOW FAN	X			23	0	0	0	0
65	M1	F	10	25	REPAIR	LEFT FORWARD ENGINE FUEL TANK	X			4	8	25	29	0
66	M1	F	10	25	REPAIR	RIGHT FORWARD ENGINE FUEL TANK	X			4	8	25	29	0
67	M1	F	10	25	REPLACE	LEFT ENGINE COMPARTMENT FUEL TANK	X			1	8	9	29	0
68	M1	F	10	25	REPAIR	LEFT ENGINE COMPARTMENT FUEL TANK	X			8	25	29	0	0
69	M1	C	10	25	SERVICE	RIGHT ENGINE COMPARTMENT FUEL TANK	X			3	4	8	9	12
70	M1	F	10	25	REPLACE	RIGHT ENGINE COMPARTMENT FUEL TANK	X			1	8	9	29	0
71	M1	F	10	25	REPAIR	RIGHT ENGINE COMPARTMENT FUEL TANK	X			8	25	29	0	0
72	M1	C	10	25	INSPECT	ENGINE FUEL TANK, RIGHT SPONSON	X			8	9	12	13	29
73	M1	C	10	25	SERVICE	ENGINE FUEL TANK, RIGHT SPONSON	X			3	4	8	9	12
74	M1	F	10	25	REPLACE	ENGINE FUEL TANK, RIGHT SPONSON	X			1	8	9	29	0

Figure 2. Sample data base structure.

necessarily be proportional to the effort. Many tasks represent maintenance of minor subassemblies, ancillary equipment, or functional repetition of other tasks (e.g., "Replace Right Road Wheel #1", "Replace Right Road Wheel #2"). Therefore, only tasks considered essertial for battle performance were used in the analysis phase.

This subset of essential, or sustainment, tasks was identified by analysts and verified by SMEs. Sustainment tasks were defined as necessary to ensure the vehicle's ability to perform its function in battle, given the BMS mission scenario. Thus, a task to replace the track was considered a sustainment task and included in the list. A task to replace a metal grill was not considered a sustainment task because the system could perform in battle without the grill. The resulting list of sustainment tasks was used for the remainder of the analysis.

Assigning task enabling criteria. The second major variable to be studied was a measure of the knowledge and training requirements, or enabling criteria, associated with each equipment system task. Enabling criteria, shown in Table 1 were developed by analyzing all tank automotive POIs and listing the required knowledge and training requirements associated with each POI task. The list were then edited and validated by the SMEs to ensure all known criteria were identified.

The final list reflects criteria chosen to capture the essential knowledge and training requirements demanded by Ordnance maintenance tasks at a level of detail consistent with that of the task descriptions. The enabling criteria along with their definitions are provided at Appendix B.

A set of rules (presented in Appendix C) were developed to systematize the assignment of enabling criteria to tasks. Analysts applied these rules to BMS tasks.

Assigning tasks to BMS maintenance levels. Tasks were sorted into BMS maintenance levels by SMEs familiar with organizational issues of BMS. The result was two lists: one for Unit maintenance tasks and the other for FR.

Assigning current MOSs to BMS maintenance levels. Each BMS task in the data base was identified with the MOSs that currently perform those tasks. This was accomplished by matching the data base tasks with those tasks listed for each MOS in POIs, occupational surveys, soldiers manuals, and FOOTPRINT data. This provided a record of all the current occupations responsible for tasks to be performed under BMS.

Verifying task data. A SME panel including members from both TOE and TDA units was assembled. The panel consisting of warrant officers and enlisted personnel including MOSs 915E, 63E,

Table 1

List of Enabling Criteria

01	Principles of Mechanical Devices and Machines
02	Knowledge of Shop Math
03	Principles of Fuels, Oils, and Lubricants
04	Use of Specialized Tools and TMDE
05	Principles of Reciprocating Engines
06	Knowledge of Units of Measurement
07	Use and Care of Bearings
08	Use and Care of Gaskets and Seals
09	Principles of Basic Electricity and Magnetism
10	Principles of Troubleshooting (Electrical)
11	Principles of Vehicle Charging Systems
12	Principles of Vehicle Electrical Systems
13	Principles of Troubleshooting (Mechanical)
14	Principles of Track Vehicle Suspension Systems
15	Principles of Wheel Vehicle Suspension Systems
16	Principles of Vehicle Steering Systems
17	Principles of Cross-Drive Transmissions
18	Principles of Drive Line Components (Tracked)
19	Principles of Drive Line Components (Wheeled)
20	Knowledge of Basic Hydraulics
21	Principles of Troubleshooting (Hydraulics)
22	Principles of Brake Systems
23	Principles of Air Induction Systems
24	Knowledge of Ground Hopping Techniques
25	Principles of Gas Turbine Engines
26	Principles of Diesel Engines
27	Principles of Spark Ignition Engine Systems
28	Knowledge of Basic Soldering Techniques
29	Principles of Fluid Systems (Non Hydraulics)
30	Principals of Basic Welding Techniques

63G, and 63H was used to verify maintenance task data. A profile of the panel is shown in Table 2. SMEs were briefed on BMS and the purpose of the study before being given the task data.

The SMEs were asked to perform four tasks:

1. Verify that the list of sustainment maintenance tasks were comprehensive and add tasks to the list as needed.

2. Verify the accuracy and completeness of the enabling criteria assigned to those tasks.

3. Assign tasks to BMS maintenance levels based on the BMS briefing.

4. Verify the assignments of current MOSs to BMS tasks.

Panel members were provided worksheets with listings of sustainment tasks and their associated enabling criteria. SMEs were asked to ensure that the list included all sustainment tasks and were encouraged to add or remove tasks as they felt necessary.

SMEs were briefed on the enabling criteria guidelines (Appendix C) and asked to use them to verify the choices made by the analysts. They were also free to add enabling criteria as appropriate.

The worksheets contained a column to indicate the maintenance level in which the task would be performed under BMS. Panel members were asked to indicate in this column whether tasks would fall under Unit or FR maintenance.

Finally, SMEs reviewed the MOSs associated with each task. This was to ensure the tasks correctly reflected the MOSs currently responsible for each task.

Update BMS task data base. The BMS task data base was modified to reflect the task, enabling criteria, and maintenance level selections made by the SMEs. SME verifications were consolidated. In general, disagreements between SMEs were resolved by choosing the majority response. These were included in the final data base version of the equipment task lists. Similarly, enabling criteria and maintenance levels chosen by a majority were used to describe tasks. These data were entered into the data base.

Finally, repetitive, functionally similar tasks within the M1 and M88 systems were eliminated from the data base. Many tasks such as "Replace Right Road Wheel #1" represented

Table 2

SME Panel Profile Data

ENLISTED PERSONNEL:

63E	Abrams Tank System Mechanic
63G	Fuel and Electrical Systems Repairer
63H	Track Vehicle Repairer

WARRANT OFFICER:

915E

Number on Panel:	6
Average Time in Service:	18.4 years
Average Time in Maintenance:	16.5 years

maintenance performed on functional and actual hardware duplicates. The analysis of commonality did not depend on the absolute number of similar tasks; rather, it examined the degree to which tasks were similar. For instance, if these tasks were found to be common to both the M1 and M88 systems, the actual number of road wheels would be of no value in determining MOS structures required to support the task. Therefore, the task "Replace Right Road Wheel #2" and its other duplicates were eliminated from the data base.

The task lists and associated task data resulting from this process were the bases for the case study analysis.

Phase Two: Task Commonality Analysis

Task analysis was performed to identify the degree of commonality between Ordnance maintenance tasks. Based on the maintenance requirements of the equipment systems, the analysis involved the systematic comparison of tasks within and between systems on the two major variables: equipment function, represented by the description of the equipment upon which the task is performed, and knowledge, represented by the enabling criteria. Common tasks were operationally defined as those having both similar task descriptions and similar enabling criteria.

How will BMS change maintenance task requirements? The answer to this question required a comparison between the current M1 and M88 maintenance tasks and those required at the Unit and FR levels of maintenance by BMS. The process used the list of BMS sustainment tasks that SMEs had sorted into Unit and FR levels of maintenance.

How will BMS affect soldier requirements? The answer to this question involved determining the degree of BMS task commonality within and between the M1 and M88. This analysis showed which of these tasks could be considered similar in equipment and knowledge requirements. The two steps in the analysis are described below. Outputs from these steps were the basis for the MOS analysis.

Determine level of equipment commonality. Tasks were sorted on equipment descriptions. Comparisons between task descriptions were made within and between the M1 and M88 systems. Tasks having similar descriptions were considered generic and grouped for further analysis. The remaining tasks were considered either M1- or M88-specific.

Determine task commonality on enabling criteria. Enabling criteria of those tasks having common descriptions were analyzed to determine the degree of similarity of knowledge requirements between tasks. Those having similar enabling criteria were considered functionally similar.

Enabling criteria associated with tasks determined to have common equipment descriptions were compared. Table 3 presents the rules that guided these comparisons. Analysts used these rules to identify those tasks having common knowledge requirements. The final list of tasks having both common equipment descriptions and knowledge requirements were used to generate MOS restructuring recommendations.

What MOS structure would best support the requirements? Analysis to answer this question was based on the degree of commonality between tasks determined in the above analyses. If a significant portion of the maintenance tasks required under BMS and currently performed by one MOS are similar to those performed by another MOS in both function and enabling criteria required, then the MOSs should be considered for merger.

Data derived from commonality analyses were displayed in three matrices. The first had cells representing the number of shared tasks between the six possible pairs of MOSs 63E, 63G, 63H, and 63J for the M1. The second displayed the same type of data for the fifteen possible paired combinations of M88 MOSs. The third matrix displayed the number of common tasks between the M1 and M88 as a function of ten possible paired combinations of MOSs responsible for tasks on both systems.

Using these matrices, analysts identified tasks performed by several MOSs on comparable equipment and requiring comparable knowledge and training. This resulted in a count of the number of common sustainment tasks currently performed by two or more MOSs which could be compared with the total number of sustainment maintenance tasks representing the M1 and M88.

MOS restructuring recommendations were based on the proportion of common tasks shared by two or more MOSs to the total equipment system tasks. A high proportion of shared tasks was indicative of the need for more comprehensive MOS restructuring analysis.

Table 3

Rules for Determining the Commonality of Enabling Criteria

1. Measurement of enabling criteria must be at the subassembly level of detail as measuring the requirements at the major assembly level of detail (power pack, hull, etc.) are too gross to gain the level of detail required.

2. In order to determine comparability of tasks based on enabling criteria, more than 70 percent of the criteria required of each matching task performed on the subassembly of both equipment systems must match (percent of tasks comparable equal the number of comparable criteria for each task divided by the number of total criteria required (% c = CC ÷ TC)).

3. Enabling Criteria #25 (Principles of Turbine Engines) and criteria #26 (Principles of Diesel Engines) are overriding criteria. Therefore, if all other enabling criteria between two engine assemblies are the same with exception of Criteria #25 or #26, the tasks must still be judged as equipment specific.

4. Subassembly tasks for which there are no corresponding subassemblies between equipment systems will automatically be considered equipment specific and separated for alternative analysis.

BMS Case Study Results

The results of the BMS case study are presented in this section. First, a summary of the BMS system sustainment data collected during the case study is presented. Second, the results of the analyses are presented and interpreted in terms of the major study questions.

Summary of BMS Case Study Data

The primary data used in the BMS case study were equipment system tasks at the subassembly level of detail. These were derived from MACs for the M1 and M88. The task data were supplemented with enabling criteria. Tasks were compared with one another on task data and enabling criteria. The following subsections describe the data. M1 and M88 task data are presented followed by discussion of the M1 and M88 enabling criteria data.

M1 task data summary. Table 4 summarizes M1 maintenance task data. The M1 MAC showed 467 tasks in maintenance levels of O&C, ORG, or DS at the subassembly level of detail. Of these, 276 were determined by SMEs to be essential for mission sustainment under BMS.

The 276 sustainment tasks were the basis for the case study analyses. SMEs categorized 77 sustainment tasks as Unit level BMS tasks, representing 28 percent of the total sustainment tasks. Under the current maintenance system, O&C tasks represent only 14 percent of the 467 tasks upon which the case study is based. This change in the proportion of O&C tasks from the current system to BMS reflects SME estimates of the migration of some task functions currently performed at the ORG level and higher down to lower levels of maintenance.

The table shows the number of BMS sustainment tasks under each of the eight maintenance functions now performed at current O&C, ORG, and DS levels. Tasks under the "Repair" function make up 41 percent of the total sustainment tasks. For the most part, these are currently performed at the DS level. Under BMS, they will occur at the same maintenance level as the "Replace" tasks.

M88 task data summary. Table 5 presents the summary data for the M88. The MAC listed 396 O&C, ORG, or DS tasks. SMEs judged 300 of these as sustainment tasks under BMS.

40 percent of the sustainment tasks were placed by SMEs at the Unit level. Under the current maintenance system, less than 13 percent of tasks below General Support are performed at the O&C level. In addition, only 37 percent of the sustainment tasks were judged to be BMS FR tasks. Because M88 operators are also maintainers, there was some SME confusion about how to categorize

Table 4

M1 Summary Data

Total M1 Tasks: 467
Total Sustainment Tasks: 276

Sustainment Tasks		
Maintenance Level	**No. of Tasks**	**% of Sustainment**
UNIT	77	28
FIELD REPAIR	193	70
UNKNOWN	6	2
	276	
Maintenance Function	**No. of Tasks**	**% of Sustainment**
ADJUST	4	<2
INSPECT	20	7
INSTALL	2	<1
REMOVE	2	<1
REPAIR	112	41
REPLACE	116	42
SERVICE	18	7
TEST	2	<1

Table 5

M88 Summary Data

Total M88 Tasks: 396
Total Sustainment Tasks: 300

Sustainment Tasks		
Maintenance Level	**No. of Tasks**	**% of Sustainment**
UNIT	122	40
FIELD REPAIR	110	37
UNKNOWN	68	23
	300	
Maintenance Function	**No. of Tasks**	**% of Sustainment**
ADJUST	23	8
INSPECT	67	22
INSTALL	2	4
OVERHAUL	2	<1
REMOVE	0	0
REPAIR	43	14
REPLACE	105	35
SERVICE	28	9
TEST	30	10

tasks. This is reflected in the large number of tasks not categorized (68). However, the difference in proportion of tasks performed by the crew under the current system and the estimates for BMS may reflect real effects of the location of task performance.

The proportion of BMS Unit to FR tasks seems to be consistent with maintenance functions. Traditional O&C tasks such as "Adjust", "Inspect", and "Service" make up most of the BMS Unit tasks. There are only 43 "Repair" tasks representing 14% of the 300 sustainment tasks. It remains to be determined if this percentage reflects the true proportion of M88 "Repair" tasks to others, shows that most M88 "Repair" tasks are not essential to battle sustainment, or whether few "Repair" tasks will occur at Unit or Field Repair levels of maintenance under BMS.

M1 and M88 BMS sustainment task comparison. Table 6 combines M1 and M88 summary data. The table shows large differences between these equipment systems in almost every category. First, only 276 of the total number of current O&C, ORG, and DS tasks for the M1 were considered sustainment tasks. For the M88, 300 tasks were judged by SMEs to be sustainment tasks under BMS.

Second, the proportion of equipment sustainment tasks was much lower for the M1 than the M88. This can be largely attributed to the difference in numbers of "Adjust", "Inspect", and "Service" tasks between the two systems.

Finally, 112 of the M1 tasks were "Repair" tasks while only 43 of the M88 tasks fell in this maintenance function category. These differences occurred because the largest number of "Repair" tasks on the M88 are performed at maintenance levels beyond those addressed by the case study.

M1 enabling criteria summary. Figure 3 presents an enabling criteria profile for the M1. The figure shows the enabling criteria judged to be required for the combined set of M1 sustainment tasks to be performed under BMS. The height of the bars represents the percentage of these tasks in which a particular enabling criteria is required. In other words, the higher the bar, the more system tasks require that enabling criteria.

The most notable feature of this profile is that over half of the sustainment tasks were judged by SMEs to require knowledge of the "Use and Care of Gaskets" (#8). Another enabling criteria determined to be required for many M1 maintenance tasks was "Knowledge of Specialized Tools and TMDE" (#4). The lack of

Table 6

Comparison of M1 with M88 Summary Data

	No. of Tasks	
Maintenance Function	**M1**	**M88**
ADJUST	4	23
INSPECT	20	67
INSTALL	2	2
OVERHAUL	0	2
REMOVE	2	0
REPAIR	112	43
REPLACE	116	105
SERVICE	18	28
TEST	2	30
TOTAL	276	300

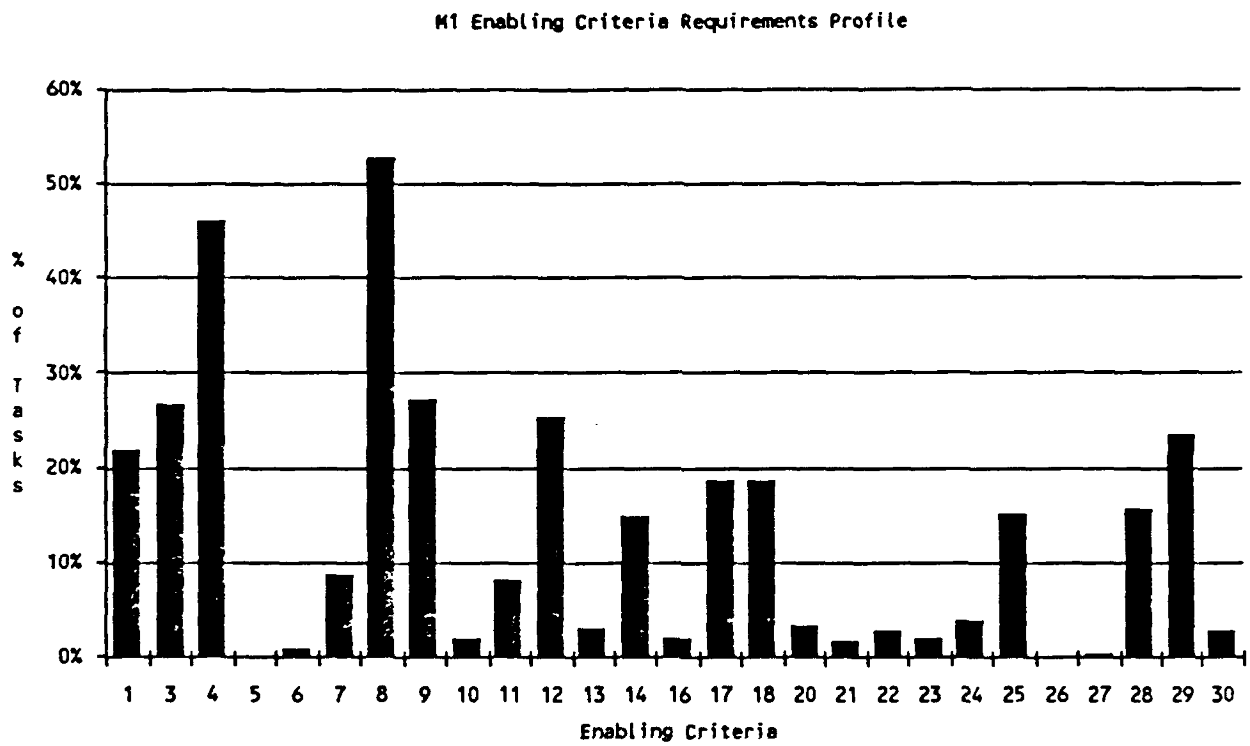

Figure 3. M1 enabling criteria requirements profile.

enabling criteria such as "Principles of Diesel Engines" (#26) was consistent with M1 system components.

M88 enabling criteria summary. Figure 4 shows the enabling criteria profile for the M88. The enabling criteria are consistent with M88 system components.

M1 versus M88 enabling criteria comparison. Figure 5 compares M1 and M88 enabling criteria profiles. Like the previous figures, the height of the bars represents the number of total system sustainment tasks for which the enabling criteria is required. The figure reflects the gross differences between these equipment systems. For instance, criteria for diesel engine (#26) appear for the M88 but not the M1.

The figure shows a substantial difference between the systems in the number of tasks requiring "Knowledge of Special Tools and TMDE" (#4). The significance of the magnitude of this difference must be determined by examining those tasks involving the use of special tools and TMDE at a greater level of detail than the tasks analyzed during the case study. However, this example illustrates how this type of early comparison is useful to highlight potential subjects for later detailed analysis.

Task Commonality Analysis Results and Conclusions

The primary assumption of TCAM and the foundation of the BMS case study was that an understanding of the degree of commonality between maintenance tasks would provide the basis for MOS restructuring decisions. The results of these analyses are presented and interpreted in terms of the major study questions.

How will BMS change maintenance task requirements? BMS Unit and Field Repair task lists compiled by SMEs were compared with current maintenance. The results of these comparisons are discussed below.

What tasks will occur at the Unit level? Task data were examined to determine if the consolidation of ORG and DS maintenance under BMS would affect the tasks performed at the Unit level. Appendix D presents lists of M1 and M88 maintenance tasks that will be performed at the Unit level of maintenance under BMS.

These lists illustrate a major change from the current O&C maintenance: the new Unit level of maintenance will require more tasks. As discussed above in the data summary sections, O&C tasks now comprise 13 to 14 percent of M1 and M88 tasks occurring below GS. The study data indicate that this percentage will be between 28 and 40 percent for the BMS Unit level. While the

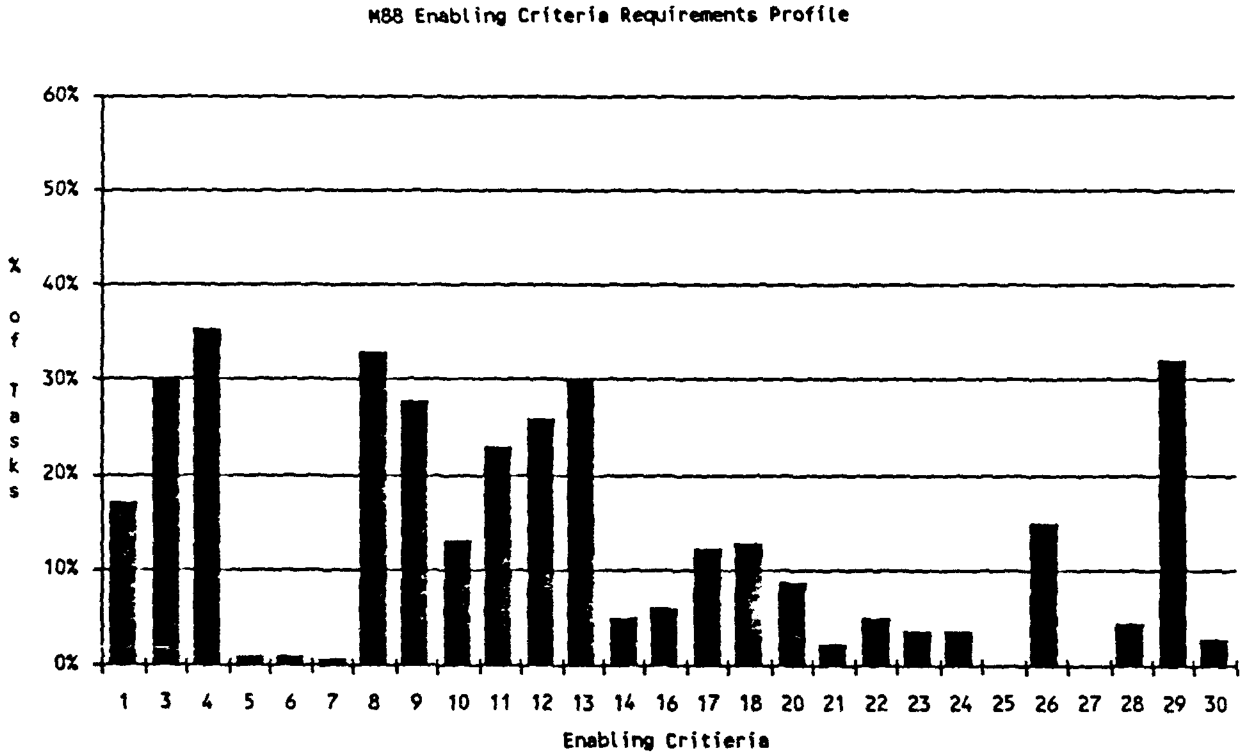

Figure 4. M88 enabling criteria requirements profile.

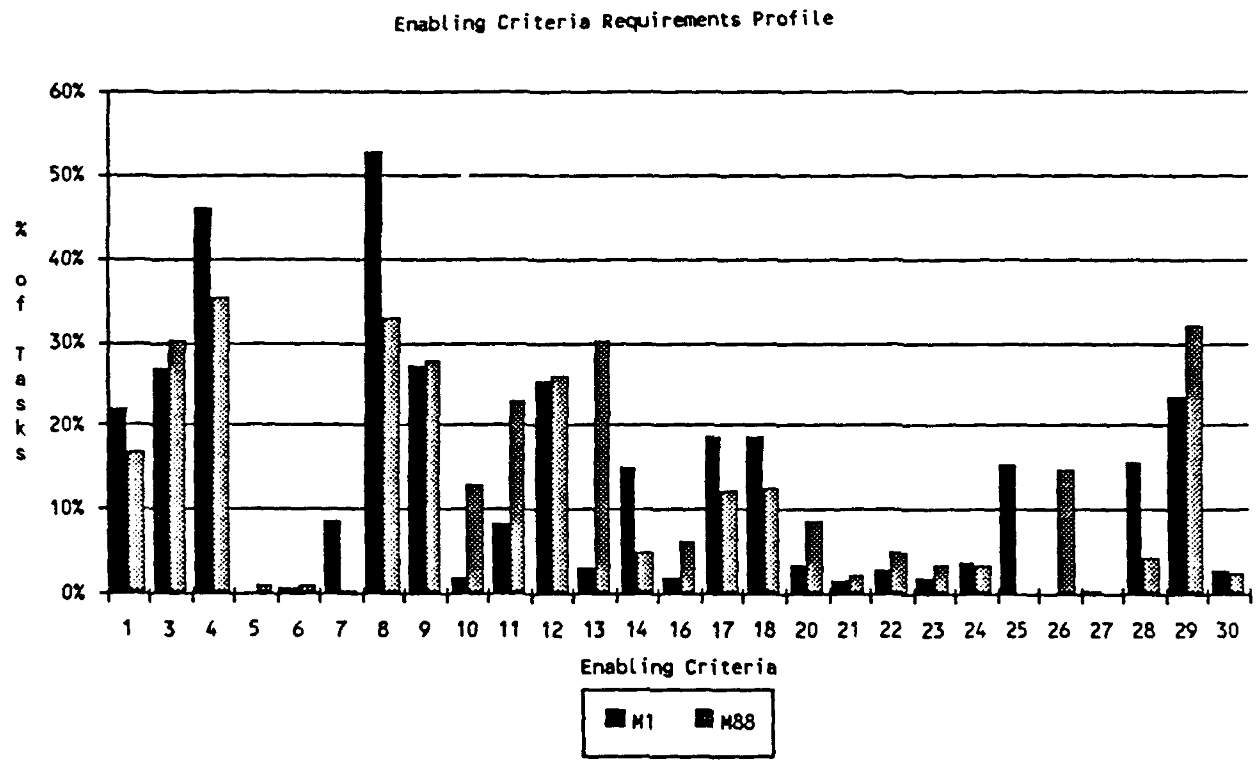

Figure 5. Comparison between M1 and M88 enabling criteria requirements profiles.

study data are based on a subset of all the tasks (i.e., sustainment tasks), the absolute numbers of tasks bear out this increase. There are now 66 O&C maintenance tasks for the M1 and 50 for the M88. The case study indicates 77 Unit tasks for the M1 and 122 for the M88. These numbers do not include the tasks dropped by the SMEs as non-sustainment tasks.

This is an important finding. Two conclusions that can be drawn from this have major implications for future MOS restructuring decisions.

The first conclusion is that M1 operator MOSs need to be included in any BMS-driven restructuring analysis. The data indicate that maintenance tasks currently performed by maintainer MOSs will be reallocated to M1 crew. Either the number of additional tasks or the nature of those tasks could have detrimental effects in terms of additional or higher skill requirements on operator MOS training, personnel, or operational requirements. The second conclusion is that training requirements for M88 maintainers should not be adversely affected by this change in number of tasks performed at the operator level because M88 operators are also maintainers and are currently trained to perform these tasks.

<u>**What tasks will occur at the Field Repair level?**</u> M1 and M88 tasks to be included in the BMS Field Repair maintenance level are listed in Appendix E. These lists reflect the consolidation of current ORG and DS maintenance tasks.

SMEs moved tasks from the current ORG level to the Unit level of BMS but did not move any ORG or DS tasks to GS. Thus, these lists represent somewhat less than the sum of ORG and DS tasks. The exact number of Field Repair tasks for each system cannot be determined because the study was based on the sustainment sample. However, a general conclusion can be drawn. The actual number of tasks performed at forward locations will substantially increase. In addition, most "Repair" functions will move forward under BMS.

This analysis shows that many tasks now performed by MOS 63H at the DS level will occur at the Field Repair level under BMS. These tasks generally involve repair of the same system components MOS 63E inspects, services, and replaces. On the other hand, few of these tasks involve repair of system components maintained by 63G or 63J. Although the maintenance functions performed by MOS 63E and 63H are different, they are performed on the same system components. This finding and their shared level of maintenance under BMS indicate that these MOSs could be consolidated. Other analyses are required to confirm this conclusion.

How will BMS affect soldier requirements? The answer to this question could not be fully determined based solely on the analysis of the M1 and M88. As analysis progressed, a significant number of maintenance task performance requirements on the M88 were found to be shared by track systems repair MOSs that are currently outside the scope of the study. Therefore, the answer to this question cannot be determined until all other track vehicle systems and MOSs can be analyzed.

Equipment system task commonality was measured in two ways: by the functional similarity of the equipment, primarily the hardware, and the knowledge required to maintain the equipment. Results of the comparisons between tasks are presented below.

Equipment commonality. Table 7 shows the number of M1 and M88 maintenance tasks that met the commonality criteria. They are categorized by equipment assemblies. The first column represents the total number of sustainment maintenance tasks for the M1 and M88. The second column shows the number of comparable tasks and the last column presents this as a percentage of the total within the equipment assembly category.

The table shows no matches between M1 and M88 maintenance tasks under the equipment assembly category of Accessory Items. This category contains miscellaneous equipment and system specific ancillary systems tasks. Since most of these represent maintenance of M88 hoists and their associated hydraulic systems, the lack of matches within this category is consistent with the equipment.

Few matches between the M1 and M88 were found in the engine assemblies. Those tasks that did match between systems represented 9 percent of the total number of tasks in that category. These were related to wiring harnesses and fuel system components like fuel injectors and tanks. These findings were consistent with the dramatic differences in engine systems between the gas turbine-powered M1 and the diesel-powered M88.

Although relatively more maintenance task matches were found within the categories of Transmission, Wheels, Tracks and Suspension, Steering, and Hull and Body, the percentages of matches were lower than intuitively expected. Several factors contribute to this finding.

These percentages possibly reflect actual differences in maintenance tasks between the M1 and M88. The similarity between systems ends with their means of locomotion; they differ greatly in both function and technology. However, this distinction cannot be made at the subassembly level of detail found in the MACs. Greater task detail, perhaps the element or steps of

Table 7

M1 and M88 Maintenance Tasks on Common Equipment

Equipment Assembly	No. of Tasks	No. of Matches	% of Matches
Engine	324	28	9
Transmission	52	10	19
Wheels, Track, Suspension	59	10	17
Steering	13	3	23
Hull and Body	15	4	27
Accessory Items	113	0	0
TOTAL	576	55	10

performance levels of detail, is required to show similarities or differences between these tasks.

Another reason few matches were found was the inconsistency in terminology between M1 and M88 MACs. For example, the M1 MAC listed tasks for the Track Drive Sprocket Wheel while the same tasks were listed in the M88 MAC as Drive Sprocket. Future applications of TCAM should include checks for these types of inconsistencies.

The last reason few matches were found was that an M1 task often did not have a M88 analog at the same maintenance level. For example, M1 transmission repairs were listed in the MAC at the DS level while the same repairs for the M88 occurred at higher levels of maintenance. In fact, only 43 M88 tasks under the "Repair" maintenance function appeared below the GS level. Other "Repair" tasks occurred at GS or higher and fell outside the scope of the study. Thus, tasks performed on similar equipment were not always compared.

These problems must be addressed before definitive conclusions can be drawn from these data. However, the data verify the equipment comparison component of the TCAM methodology can match tasks performed on functionally similar equipment.

Task knowledge requirements commonality. Table 8 shows those tasks meeting the criteria for equipment and enabling criteria commonality, categorized by maintenance function. The first column contains those tasks that matched on equipment. The second column represents the number of tasks from the first column that also matched enabling criteria. The last column expresses the number of tasks matching on equipment and enabling criteria as a percentage of those matching on equipment alone.

In most cases, M1 and M88 tasks that matched on equipment also matched on enabling criteria. These findings are summarized as follows:

1. Maintenance tasks on fuel injectors, electrical fuel pumps, fuel tanks, generators, starters, and wiring harnesses were all found to be comparable in terms of enabling criteria.

2. Transmission replacement and repair tasks and replacement of the final drive assemblies were also comparable on enabling criteria between the M1 and M88. Dissimilarities on enabling criteria between these systems were revealed in tasks related to transmission adjustment and replacement of component parts.

Table 8

Maintenance Tasks with Common Equipment and Knowledge Requirements

Equipment Assembly	No. of Matching Tasks	No. of Enabling Criteria Matches	% of Matches
Engine	28	26	93
Transmission	10	6	60
Wheels, Track, Suspension	10	10	100
Steering	3	0	0
Hull and Body	4	4	100
TOTAL	55	46	84

3. Wheels, tracks, and suspension tasks that matched between both equipment systems were comparable in terms of enabling criteria. Comparison of enabling criteria revealed commonality in the inspection, repair, and replacement of track, track shoe, and hub and arm assemblies.

4. No steering assemblies were comparable in terms of enabling criteria. These tasks consisted of repair and replacement of steering and shifting controls.

5. Matching hull and body tasks were comparable. These tasks consisted of repair of valves, prisms, and periscopes.

Of the tasks meeting the functional comparability criteria, there was a very high degree of comparability of enabling criteria required to perform the tasks. 83 percent of the tasks meeting the equipment commonality criteria were also comparable in enabling criteria. Although these tasks represent a small portion of the total of both systems, the high degree of comparability between them supports the intuitive observation that similar system components have similar knowledge requirements. If this observation is accurate, it would be evidence of the validity of the commonality analysis component of the TCAM.

What MOS structure would best support BMS requirements? This question also could not be fully answered without benefit of analysis on all track vehicle systems and MOSs. However, analysis did reveal that the co-occurrence between the number of field repair tasks performed on the M88 and the MOSs responsible for performing the tasks indicates that MOSs 63E, 63H, 63N, and 63T may be candidates for merger analysis.

The results of the analysis to answer this question are presented in the following subsections. The answer depends on data produced by three different comparisons of BMS maintenance task requirements with the MOSs now performing those tasks.

MOS analysis between M1 and M88 systems. The 55 tasks meeting equipment and enabling criteria commonality tests were categorized by the five MOSs currently responsible for their performance. Table 9 is a matrix that illustrates the number of equivalent tasks performed by each of the ten possible unique MOS-by-MOS pairs. Three of the tasks are currently performed by a single MOS and were not included in the matrix. The last column indicates the total number of times the MOS in the corresponding row appeared in the list of common tasks. The

Table 9

Between-Systems Common Maintenance Tasks Currently Shared by MOSs

MOS	63G	63H	63N	63T	TOTAL NO. OF UNIQUE MATCHING TASKS PERFORMED BY MOSs
63E	3	15	13	13	20
63G		2	1	1	6
63H			2	2	19
63N				0	17
63T					17

column total is greater than the 55 common tasks because MOSs often appeared in several of the tasks.

Between the M1 and M88, MOS 63E and 63G now share responsibility for three tasks that can be considered essentially equivalent in both hardware and knowledge requirements. Similarly, the 63E and 63H MOSs now share 15 such tasks. In general, MOSs that share a significant number of common tasks should be considered for merger. However, a definitive recommendation on MOS merger cannot be made on the current data set since only a small percentage of the overall system maintenance tasks are comparable. Before any recommendation can be made, the M2, M3, M60, M109, and M113 series vehicles must be analyzed to determine the maintenance tasks requirements for all tracked vehicle systems under BMS.

Data from these systems would be incorporated into the matrix shown in the table. The data suggest that the TCAM method provides a method for making complex task comparisons across many equipment systems.

MOS analysis within the M1. Table 10 shows the M1 Field Repair tasks and the four maintainer MOSs currently responsible for their performance. Each cell in the matrix represents the number of tasks performed by each of the six possible unique MOS-by-MOS pairs.

While MOS 63E is currently responsible for 108 sustainment tasks that will fall in the Field Repair level of maintenance under BMS, only six of these tasks are shared with other MOSs. Of the 193 total Field Repair tasks, 63E shares responsibility with 63G for one Field Repair task; responsibility is shared with 63H for five tasks. These data indicate very little within-system duplication of task duties for the M1 maintainer MOSs at the Field Repair level.

These results must be compared with those of the other analyses before conclusions can be drawn about MOS consolidation opportunities.

MOS analysis within the M88. Table 11 provides the same type of data for the M88 maintainer MOSs. Because there is currently no distinction between M88 operators and maintainers, the BMS Unit and Field Repair tasks were grouped. Within the M88 system there are a significant number of Field Repair tasks for which two or more MOSs are responsible. MOSs 63E, 63H, 63N, and 63T share responsibility for 178 of the 300 (59 percent) M88 sustainment tasks.

Table 10

M1 Maintenance Tasks Currently Shared by MOSs

MOS	63G	63H	63J	TOTAL NO. OF UNIQUE TASKS PERFORMED BY MOSs
63E	1	5	0	108
63G	[redacted]	0	0	45
63H	[redacted]	[redacted]	0	43
63J	[redacted]	[redacted]	[redacted]	2

Table 11

M88 Maintenance Tasks Currently Shared by MOSs

MOS	63G	63H	63J	63N	63T	TOTAL NO. OF UNIQUE TASK PERFORMED BY MOSs
63E	8	178	1	178	178	178
63G		20	0	8	8	36
63H			1	178	178	273
63J				1	1	11
63N					178	178
63T						178

The degree of co-occurrence between the number of field repair tasks on the M88 and the MOSs responsible for performing the tasks would indicate that MOSs 63E, 63H, 63N, and 63T should be considered for merger analysis. Since each of these MOSs are also responsible for performing maintenance on other track automotive systems, these other systems should be similarly assessed before a decision to assess these MOSs for restructuring is made. However, on the basis of the M88 alone, the data represent strong evidence that these MOSs potentially could be consolidated.

Recommendations

This section has two purposes. The first is to provide the Ordnance Center and School with recommendations based upon the results of the BMS case study. The second is to present the tradeoff issues related to these recommendations that can be derived from use of the TCAM. These issues serve as potential focal points for future analyses.

Recommendations

The following recommendations have been derived from application of TCAM to BMS and the data upon which the model is based.

1. MOSs 63G and 63J should not be considered for any further study in terms of possible merger with other track automotive MOSs based on the uniqueness of tasks performed by these MOSs on the M1 and M88 and the lack of task commonality between these MOSs and the other MOSs performing maintenance on these two systems.

2. Based on the significance of combining component replacement and component repair tasks at the same maintenance level, all track automotive systems and MOSs should be analyzed in order to determine the effects on these systems on the merger of ORG and DS maintenance under the BMS concept.

3. Operator and crew maintenance requirements should be significant factors in possible restructuring decisions for MOSs performing maintenance on the M1 tank because a large number of tasks will be moved from the ORG maintenance level to operator and crew level maintenance as a result of BMS.

4. Operator and crew maintenance tasks should be considered in any restructuring of MOSs performing maintenance on the M88. The major reason for this recommendation is that operator and crew maintenance on the M88 is performed by MOSs 63E, 63H, 63N, and 63T. These MOSs are also the primary maintainers of this system at the FR level of maintenance. Therefore, any restructuring or merging of these MOSs will likely affect the other MOSs because they are linked by the common tasks each MOS performs on the M88.

5. Analysis of the M2, M3, M60, M113, and M109 series of vehicles should be strongly considered. Analysis on the

M1 and M88 indicate significant economies may be realized from merging MOSs 63E, 63H, 63N, and 63T.

Although a complete analysis of the systems would be required to verify this, a preliminary review of two subassemblies common to the M2, M3, M60, M88, and M113 indicates a high level of functional comparability between systems. This review revealed that transmission and final drive tasks performed on these systems were functionally comparable in 37 of 41 total transmission and final drive specific tasks.

The review also indicated that many engine-related tasks were functionally comparable. That is, requirements to perform tasks such as repair, replace, adjust, and test like components were comparable from one system to the next. This suggests detailed analysis of maintenance functions performed on the M2, M3, M60, M88, and M113 will demonstrate a much greater degree of commonality than was revealed between the M88 and M1.

These recommendations are results of conclusions based on the analysis of tasks and enabling criteria data. For the BMS scenario and the time frame in which this study was required, this approach is fully satisfactory. For other potential doctrinal and MOS restructuring issues, analysis may well need to also consider tasks loading and equipment density.

Tradeoff Considerations

At some point in the analysis of track automotive MOSs, tradeoffs are going to be required. Although well defined MOS restructuring recommendations could not be made based solely on the data provided by analysis of the M1 and M88, there are tradeoff considerations that will eventually need to be addressed.

Under the BMS concept, both maintenance by component replacement and maintenance by component repair functions will be performed at the same level. The question to be ultimately answered is: Should system maintainer MOSs currently performing maintenance by component replacement on the M1, M2, M3, M60, M88, M109, and M113 series of tracked vehicles be merged with MOS 63H which performs maintenance by component repair on all of these systems? Although this question cannot be fully answered at this time, the preliminary results of TCAM analysis on the M1 and M88 systems indicates that economies can be realized by merging the tasks performed by system maintainers and the 63H.

As analysis of track automotive MOSs progresses, several maintenance task and knowledge requirement issues will arise and present possible tradeoff considerations. Table 12 lists a sample of the task and knowledge requirement issues that must be addressed if any future restructure or merger of Ordnance track automotive maintenance MOSs is to be successful.

This list of task and knowledge requirement issues provides a focus for further analyzing the maintenance MOSs in terms of developing both new maintenance MOS structures and training. For example, once all track automotive maintenance tasks are identified through TCAM, selections can be made as to which maintenance tasks are required to sustain the track systems in combat under the BMS concept. These sustainment tasks become the baseline from which to develop maintenance MOS structures and to assess MOS knowledge and training requirements.

From the task baseline, decisions can be made on which tasks constitute an MOS and how the tasks should be aggregated in order to compose the MOS structure. As MOSs are defined by both the tasks they are expected to perform and their structure, proper MOS tasks selection and aggregation are critical to both training development and reliable performance of the MOS in the field.

The task baseline also provides a vehicle with which to assess knowledge requirement issues and the capability to make determinations on how, when, and where MOS tasks should be trained. Knowledge requirement issues have a direct bearing on task training decisions and should be developed and addressed prior to making task training selections.

Teaching 100 percent of the tasks required to perform sustainment maintenance in resident training is not feasible. Therefore, decisions and tradeoffs will need to be made in order to optimize task training. Task training tradeoffs may include making decisions on such issues as:

1. Can tasks be trained through use of job performance aides?

2. Can tasks be trained through self-teaching exportable training packages?

3. Can formal on-the-job training be effective in training the tasks?

4. Is resident training required in order to properly train the tasks?

Table 12

Tasks and Knowledge Requirement Issues

Tasks Issues	Knowledge Issues
What are the Sustainment Tasks Required?	What are the Knowledge Requirements Demanded by the Tasks?
Which Tasks Constitute an MOS?	Will the Restructure or Merger of Tasks Increase Knowledge Requirements?
How Should the Tasks be Aggregated?	Are Knowledge Requirements Comparable Between Basic Tasks and More Advanced Tasks?
How Should the Tasks be Trained?	
Where Should the Tasks be Trained?	
When Should the Tasks be Trained?	

Focusing on task and knowledge requirement issues with respect to making decisions on whether to restructure or merge track automotive MOSs will ensure that both training and MOS capabilities fit the changes in track vehicle systems maintenance requirements resulting from the implementation of BMS.

Acronyms

ALB-F . .	Airland Battle Future
BMS . . .	Battlefield Maintenance System
DS . . .	Direct Support Maintenance
FR . . .	Field Repair Maintenance
GM . . .	General Motors
GS . . .	General Support Maintenance
MAC . . .	Maintenance Allocation Chart
MOS . . .	Military Occupational Specialty
O&C . . .	Operator and Crew
ORG . . .	Organizational Maintenance
POI . . .	Program of Instruction
SME . . .	Subject Matter Expert
TCAM . .	Task Commonality Analysis Model
TMDE . .	Test Measurement and Diagnostic Equipment
USAOCS .	U.S. Army Ordnance Center and School

References

Headquarters Department Of the Army. Military Occupational Classification Structure Development and Implementation. Army Regulation 611-1. Washington, D.C.: Headquarters Department of the Army, 1989.

Headquarters Department Of the Army. Enlisted Career Management Fields and Military Occupational Specialties. Army Regulation 611-201. Washington, D.C.: Headquarters Department of the Army, 1989.

Headquarters Department Of the Army. Enlisted Career Management Fields and Military Occupational Specialties. Army Regulation 611-201. Washington, D.C.: Headquarters Department of the Army, 1989.

Headquarters Department Of the Army. Unit Maintenance Operations. Army Field Manual 43-5. Washington, D.C.: Headquarters Department of the Army, 1989.

Headquarters Department Of the Army. Maintenance Operations (Direct Support). Army Field Manual 43-11. Washington, D.C.: Headquarters Department of the Army, 1987.

Headquarters Department Of the Army. Division Maintenance Operations. Army Field Manual 43-12. Washington, D.C.: Headquarters Department of the Army, 1989.

Headquarters Department Of the Army. Force Integration. Army Field Manual 100-11. Washington, D.C.: Headquarters Department of the Army, 1988.

Headquarters Training and Doctrine Command (TRADOC). TRADOC Regulation 350-7, Systems Approach to Training. Fort Monroe, VA: Headquarters Training and Doctrine Command. 1982.

Headquarters Training and Doctrine Command (TRADOC). TRADOC PAM (Draft) 525-XX, Military Operations U.S. Army Operational Concept for Airland Battlefield Maintenance System. Headquarters Training and Doctrine Command.

Technical Manual (TM) 9-2350-252-1-5, Section II, Maintenance Allocation Chart, M2, M2A1, M3, and M3A1 Bradley Fighting Vehicle.

Technical Manual (TM) 2350-253-20-1, Section II, Maintenance Allocation Chart, M60A3 Main Battle Tank.

Technical Manual (TM) 9-2350-255-20-1-5, Appendix B, Maintenance Allocation Chart, M1 Abrams Main Battle Tank.

Technical Manual (TM) 9-2350-256-20, Section II. Maintenance Allocation Chart, M88 Recovery Vehicle.

Headquarters U.S. Army Armor School. Program of Instruction, MOS 19K10, M1/M1A1 Abrams Armor Crewman. Headquarters U.S. Army Armor School. 1988.

Headquarters U.S. Army Ordnance Center and School. Program of Instruction, 611-63E10, M1 Abrams Tank System Mechanic. Headquarters U.S. Army Ordnance Center and School. 1988

Headquarters U.S. Army Ordnance Center and School. Program of Instruction, 611-63G10, Fuel and Electric Systems Repairer. Headquarters U.S. Army Ordnance Center and School. 1987.

Headquarters U.S. Army Ordnance Center and School. Program of Instruction, 611-63H10, Track Vehicle Repairer. Headquarters U.S. Army Ordnance Center and School. 1986

Headquarters U.S. Army Ordnance Center and School. Program of Instruction, 611-63J10, Quartermaster and Chemical Equipment Repairer. Headquarters U.S. Army Ordnance Center and School. 1987.

Headquarters U.S. Army Ordnance Center and School. Program of Instruction, 611-63N10, M60A1/A3 Tank System Mechanic. Headquarters U.S. Army Ordnance Center and School. 1988.

Headquarters U.S. Army Ordnance Center and School. Program of Instruction, 611-63T10, Bradley Fighting Vehicle System Mechanic. Headquarters U.S. Army Ordnance Center and School. 1988.

Headquarters U.S. Army Ordnance Center and School. Approved Critical Task List (Generic), MOS 63E, Skill Level 1, M1 Abrams Tank Systems Mechanic. DP # 127, Recovery Vehicle Crewman, DP # 090/091. Headquarters U.S. Army Ordnance Center and School. 1986.

Headquarters U.S. Army Ordnance Center and School. Approved Critical Task List (Generic), MOS 63G, Skill Level 1, Fuel and Electrical Systems Repairer, DP #035. Headquarters U.S. Army Ordnance Center and School. 1986.

Headquarters U.S. Army Ordnance Center and School. Approved Critical Task List, MOS 63H, Skill Level 1, Track Vehicle Repairer, DP #113. Headquarters U.S. Army Ordnance Center and School. 1982.

Headquarters U.S. Army Ordnance Center and School. Approved Critical Task List (Generic), MOS 63H, Skill Level 1, Track Vehicle Repairer, DP #113 Recovery Vehicle Crewman, DP #090. Headquarters U.S. Army Ordnance Center and School. 1986.

Headquarters U.S. Army Ordnance Center and School. Approved Critical Task List (Generic), MOS 63J, Skill Level 1, Quartermaster and Chemical Equipment Repairer, DP #085. Headquarters U.S. Army Ordnance Center and School. 1986.

Headquarters U.S. Army Ordnance Center and School. Generic Critical Task List versus Critical Subtask Title, MOSs 63D, 63E, 63N, and 63Y. Headquarters U.S. Army Ordnance Center and School. No Date.

Headquarters U.S. Army Ordnance Center and School. Draft Training and Doctrine Command Phamplet (TRADOC PAM) 525-XX U.S. Army Operational Concept for the Battlefield Maintenance System (BMS). 1990.

APPENDIX A

TASK COMMONALITY ANALYSIS MODEL (TCAM)

Appendix A

Task Commonality Analysis Model (TCAM)

This section describes the Task Commonality Analysis Model (TCAM) developed during the BMS case study. It is a tool to provide the minimum data necessary to determine whether to initiate formal MOS restructuring analysis.

The outputs of the process include recommendations for potential maintainer MOS merger or restructuring actions and the tradeoff issues that can be derived from the data. Although other issues (e.g., aptitude area scores, training time, women in the Army, etc.) must also be considered during the course of an MOS restructuring effort, TCAM is designed only to test commonality between systems and MOSs as a bases initiating formal MOS restructuring actions.

First, an overview of the TCAM is presented. Second, the rationale for TCAM's approach is discussed. Third, a detailed description of the model and its use is presented in terms of its inputs, constraints, and outputs. Finally, TCAM's limitations and strengths are discussed.

Overview of the TCAM

An overview of TCAM is presented in Figure A-1. The figure shows the major steps in the process and the relationship of the model to formal MOS restructuring analysis.

TCAM can be initiated by a number of events. The introduction of new equipment systems, the change in manpower authorizations, the implementation of new doctrine, or field performance deficiencies can all create a need to review whether current MOS structures are capable of supporting new requirements brought about by these changes.

As illustrated in the figure, TCAM can serve as a bridge between any of these initiating events and formal MOS analysis required by them. In this role, the data produced by TCAM can define the scope of future analyses, providing well-defined focus to those efforts.

TCAM Rationale

Two premises form the foundation for the TCAM. First, MOSs should be considered for consolidation if a significant number of tasks performed by two or more MOSs at the same level of maintenance are comparable. Second, MOSs should be considered for consolidation if two or more MOSs perform a significant number of tasks which are identical with respect to one or more criteria (e.g., some percentage of the shared required

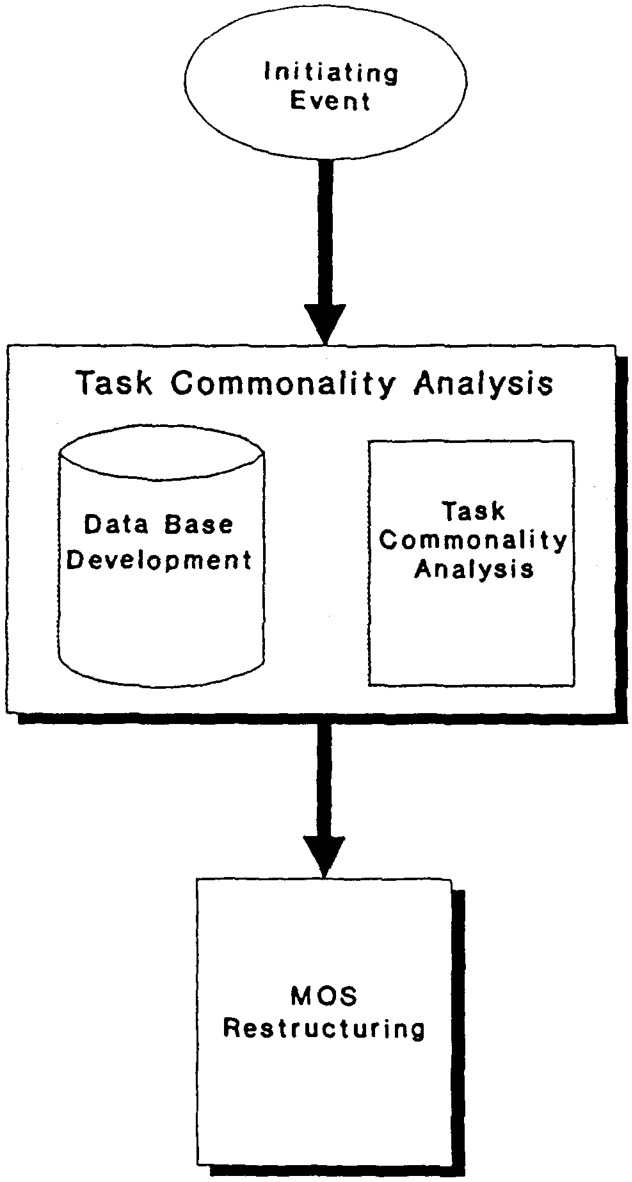

Figure A-1. Overview of the TCAM process.

knowledges). TCAM was developed to test for either or both of these conditions to generate MOS restructuring recommendations based on equipment system requirements. These tests, in the form of between-equipment systems comparisons and within-equipment systems comparisons are described in general terms.

Functional comparability of tasks: between-systems comparisons. The TCAM attempts to provide MOS restructuring recommendations to meet new mission requirements or change in organizational structure by creating an understanding of the similarities and differences between tasks performed by MOSs on all equipment systems on which MOSs work. If there is significant duplication of mission function between two or more MOSs under the new system, then a merger action for these MOSs should be considered.

The relationship between task commonality and MOS structure is illustrated in Figure A-2. The figure represents the total number of maintenance tasks on several fictional equipment systems and shows the proportional distribution of these tasks between MOSs. The figure shows that MOSs 00Y and 00V share a large proportion of common tasks. Most of MOS 00Vs' tasks are equipment specific. This distribution of tasks suggests that MOS 00Y and 00V should be considered for merger. TCAM provides a systematic, analytic means to measure whether significant numbers of the tasks MOSs will perform are common.

TCAM uses two major variables to describe task commonality: equipment task data and the general knowledge requirements to perform those tasks. The foundation of the method is equipment task data. Equipment systems determine the maintenance tasks and the maintenance tasks determine the soldier knowledge needed to perform them. Since MOS structures are defined by the tasks trained and performed, required maintenance tasks and their associated knowledge requirements represent potential MOS structures based directly on the required maintenance.

The TCAM process focuses on the equipment subassembly level of detail. Maintenance data on equipment subassemblies are readily available and detailed enough to reflect the effects of system change on maintenance tasks. A lesser level of detail, such as the system level, might not show important changes in job requirements resulting from such change. Findings derived from task steps of performance would yield more detailed information than necessary.

The second major variable important to TCAM between-systems analysis is a measure of the knowledge and training requirements, or enabling criteria, associated with each equipment system task. Examples of enabling criteria used during the BMS case study are presented in Appendix B.

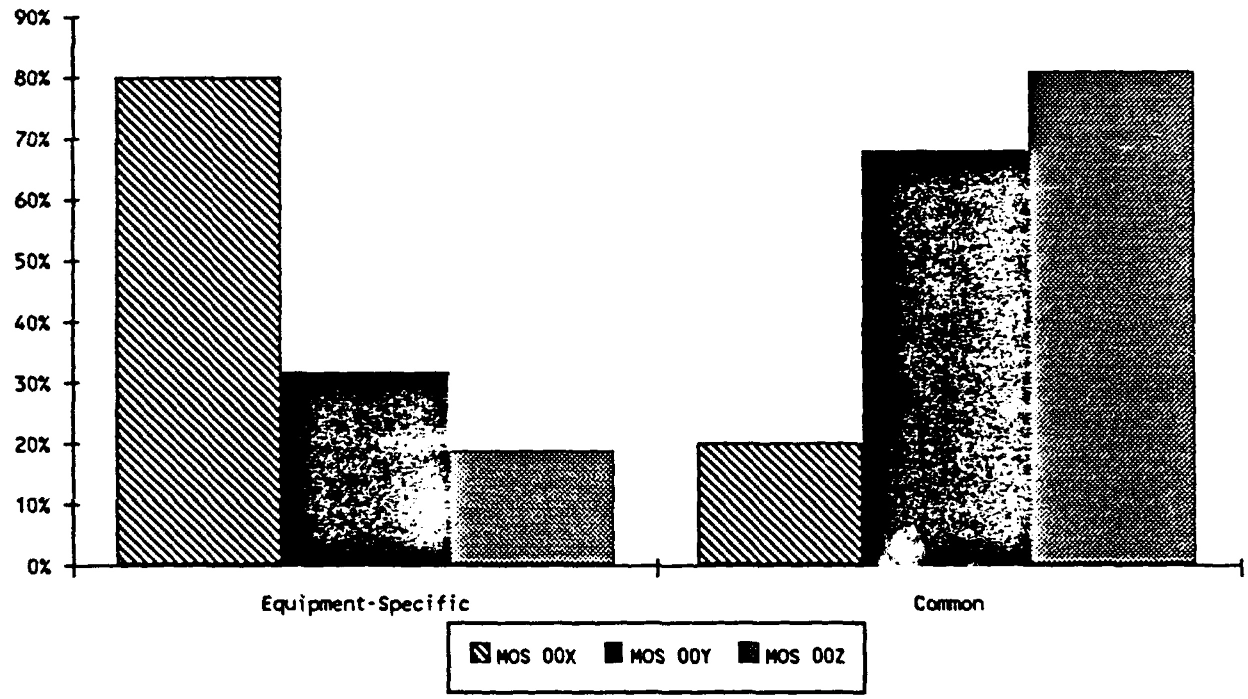

Figure A-2. Relationship between task comparability and MOS structure.

Enabling criteria are system specific measures of the general maintenance concepts a soldier must know to do his or her job. This specificity is achieved by deriving the maintenance knowledge requirements of the systems under investigation from system maintenance materials and SMEs. While this does not rule out the need to validate enabling criteria, it assures some measure of internal validity for comparisons between system maintenance tasks based on the criteria.

Although several other task measures, such as time of performance, tools required, and workload can be used to compare tasks, enabling criteria are more suited to the objectives of the TCAM. Enabling criteria are relatively easy to catalog. Comparisons between them yield results consistent with the subassembly level of task detail examined by the TCAM process, while time, tool, and other indices represent greater detail than required by TCAM.

Identifying identical tasks: within-systems comparisons. The second major premise of the TCAM is that MOSs should be considered for merger if they perform identical tasks at the same level of maintenance. The TCAM compares tasks within equipment systems to provide a measure of the number of tasks currently shared by MOSs. Figure A-3 illustrates this concept.

The figure represents the proportional distribution of maintenance tasks required by a fictional equipment system at a particular level of maintenance. If the number of tasks shared by MOSs is significant, then restructuring those MOSs may yield some economies and should be considered. In the figure, MOS 00X and 00X share a major portion of the total tasks performed on the system. This suggests that these MOSs may be good candidates for merger.

The TCAM examines equipment system tasks and the MOSs currently performing them. The within-systems analysis consists of counting the frequency co-occurrence of one MOS with another on the identical task and comparing the final result against the total number of system tasks.

TCAM Process

The two major phases of TCAM are: Data Base Development and Task Commonality Analysis. Figure A-4 illustrates the TCAM process in detail. Each phase of the TCAM and its component parts is discussed in the following subsections.

Data base development phase. This phase of the TCAM process outlines the goals, defines the scope, and collects the data and assembles in into a data base. These components of the data base development phase are described below.

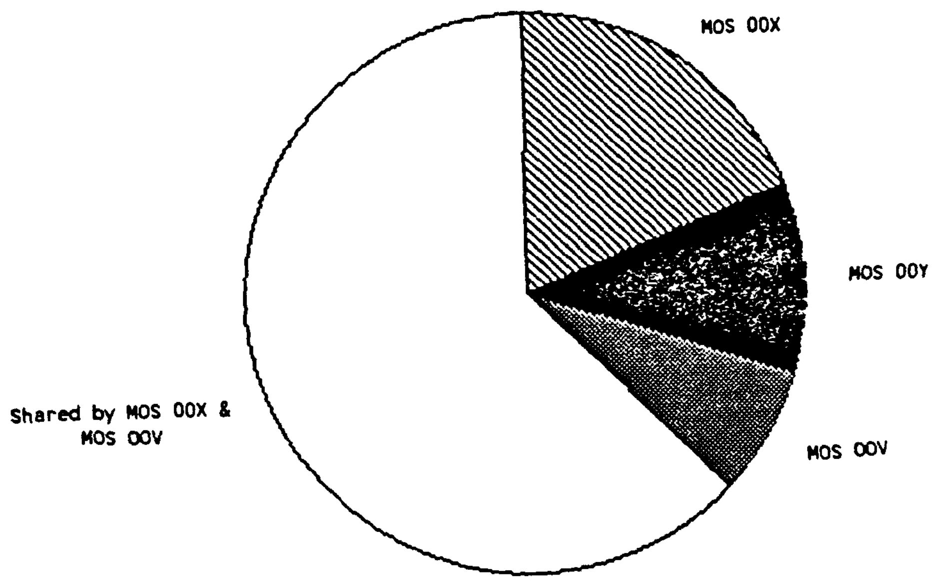

Figure A-3. Relationship between MOS tasks within equipment systems.

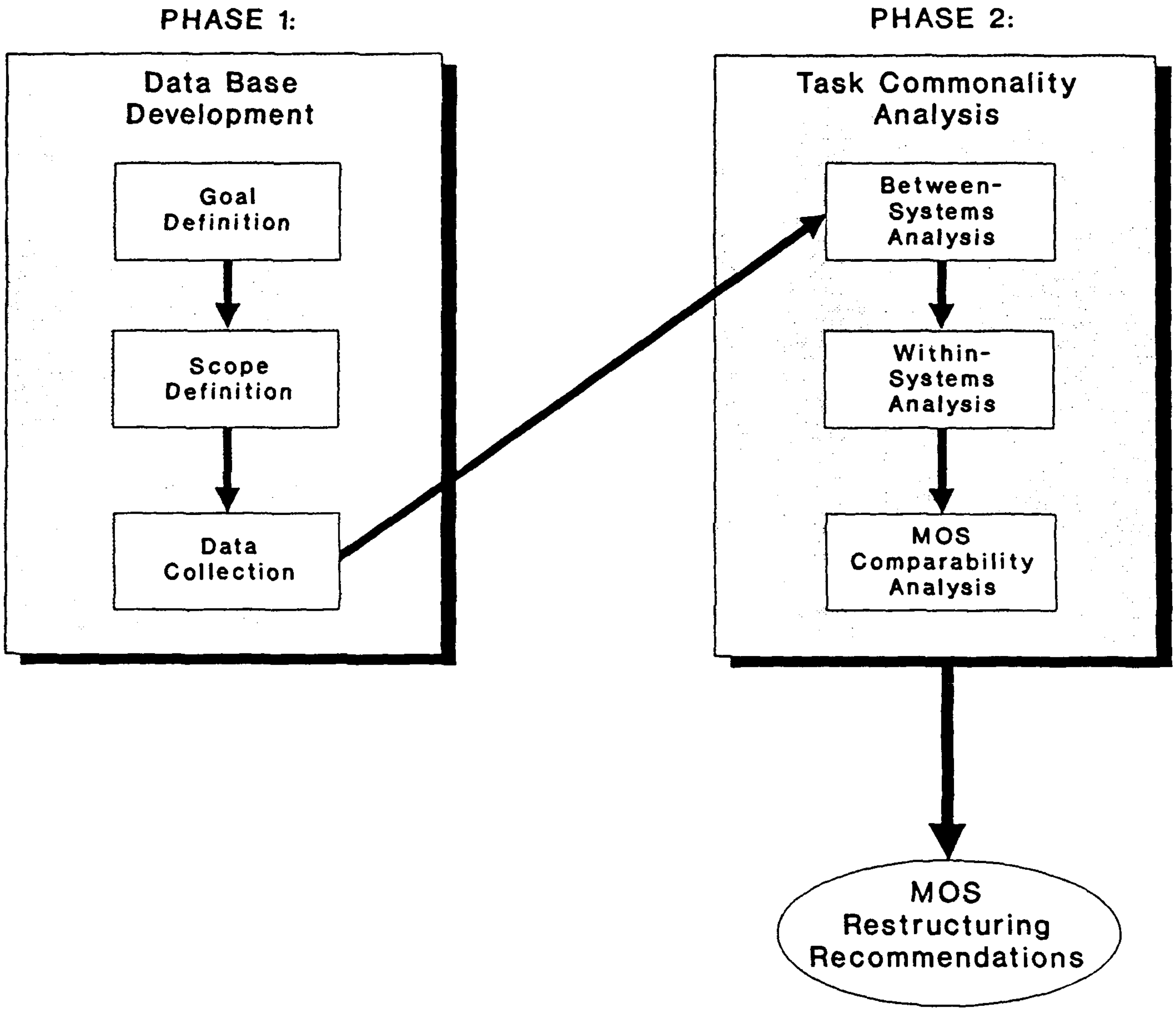

Figure A-4. TCAM process.

<u>Define the study goals</u>. The first step in the phase is Goal Definition. This is simply a statement of the objectives of the study posed as questions such as: How will current maintenance task requirements be changed by the consolidation of ORG and DS maintenance for BMS?

<u>Define scope of the study</u>. The second step is Scope Definition. It starts with the development of a description of the maintenance mission. The organization of the force required to meet the mission, the equipment, and the MOSs affected, as a minimum, must be described. Inputs to this phase are the operational and organizational (O&O) plan, new doctrine, and other documents that describe operational goals.

These data are consolidated into a document that contains descriptions of the maintenance mission, equipment systems required to achieve that mission, and the roles of MOSs in support of the mission. The document guides the rest of the analysis.

<u>Collect the data</u>. The last step, Data Collection, is performed to describe and record the environment under which future maintenance activities will occur in enough detail to yield clues as to how that context will affect current MOSs. This is accomplished by the creation of equipment requirements profiles.

The objective is to describe the equipment tasks required to support the mission. Because MOS structures will be developed to support these tasks, it is critical that the equipment profiles be expressed in terms of what tasks are required in the context of the mission scenario developed in the initial phase.

Table A-1 outlines the three step process of creating these profiles. First, data are collected. Equipment requirements profiles are derived from available equipment task data sources. Maintenance data bases, MACs, POIs, occupational surveys, vendor task lists, and Field Manuals are potential sources of task information.

The second step is the assembly of the tasks required to meet the mission objectives into a comprehensive profile of mission requirements. Equipment task lists are reviewed to identify those tasks at the equipment subassembly level of detail that are required by the mission. These are placed in a task data base. The completed data base is verified against the mission scenario document by SMEs.

The third step is the addition of information used to measure the knowledge requirements of the items in the task list.

Table A-1

Equipment Requirements Profile Generation Process

1.	Collect Equipment Task Data Resources: MACs, POIs, maintenance data base, Field Manuals, occupational surveys
2.	Create Profile of Mission Requirements a. Identify tasks required by equipment systems b. Assemble tasks in data base c. Verify task data against mission requirements Resources: Mission description document, SMEs
3.	Determine task knowledge requirements a. Assemble SME panel b. SMEs assess task knowledge requirements and express them as enabling criteria Resources: Mission description document, SMEs

In this step, knowledge requirements of each task are assessed by SMEs and expressed as enabling criteria associated with the tasks.

A panel of SMEs familiar with the current equipment systems required for the new mission is assembled. Since it is important that knowledge requirements assessments be made in light of the mission requirements, SMEs should be familiar with the objectives of the organizational change that initiated the process. In addition, the panel should be briefed on the details of the mission to ensure that each panel member has the same understanding of the mission criteria.

Task commonality analysis phase. The objective of this phase is to determine the level of commonality of equipment maintenance requirements within and between systems. Outputs from this phase support MOS restructuring recommendations.

The data required for comparability analysis are the equipment profiles generated in the previous TCAM phase. Three analyses are performed in this phase: between-systems analysis, within-systems analysis, MOS comparability analysis. The first two analyses provide data that feed the third analysis.

Between-systems analysis. Table A-2 outlines how tasks are compared between systems on two dimensions: equipment and knowledge requirements. First, maintenance tasks from one equipment system are compared with tasks from all other equipment systems on the equipment dimension. Tasks performed on similar hardware are sorted so that wheels are grouped with wheels, engines with engines, fuel pumps with fuel pumps.

Second, enabling criteria associated with tasks are compared with those of matching tasks. Guidelines were developed during the BMS case study to help analysts determine whether sets of enabling criteria are similar to others (see Table 2). The guidelines are necessary because simple one-to-one comparisons between enabling criteria are not possible. The importance of any one enabling criterion is dependent on the context of the particular task. For example, the criterion Knowledge of Basic Hydraulics may be incidental to one task but the key criterion for performance of another task. In other words, enabling criteria weighing is variable from task to task.

The third step of the process is to list tasks that match on the enabling criteria. Finally, tasks in this list are described in terms of the percentage of hardware and enabling criteria matches versus the total number of tasks in the weapons system.

Within-systems analysis. Table A-3 presents the steps in analysis of task commonality within systems. The initial step is

Table A-2

Between-Systems Task Comparability Analysis

1. Group equipment systems tasks by hardware similarity.

    a. Categorize tasks by general equipment (e.g., engines, transmissions, etc.)

    b. Match tasks by equipment function within these categories (e.g., Engines: M1 Oil Filter and M88 Oil Filter)

2. Determine degree of enabling criteria similarity between matching tasks.

    a. Apply rules of enabling criteria comparability to enabling criteria of tasks in the list

    b. List tasks that meet these rules

3. Determine the number of common tasks currently shared by MOSs.

    a. MOSs associated with all systems in the analysis are placed in the border rows and columns of the matrix

    b. Cells are filled with counts of the number of shared common tasks between MOS pairs

Table A-3

Within-Systems Task Comparability Analysis

1. Generate equipment-specific task sets

   a. Group tasks by equipment system membership and maintenance level

   b. List those tasks within each system for which two or more MOSs are currently responsible

2. Determine MOS-MOS co-occurrence frequency

   a. A matrix is developed for each specific equipment system

   b. MOSs associated with all systems in the analysis are placed in the border rows and columns of each matrix

   c. Cells are filled with counts of the number of required equipment system tasks currently shared by each possible MOS pair the development of system-specific task lists. Then, tasks are sorted by the maintenance levels in which they will be performed.

The analysis is simply a count of tasks of a single system for which two or more MOSs are currently responsible. Matrices expressing the number of system tasks currently shared by MOSs are developed for each equipment system. The count is repeated for as many equipment systems as are involved in the analysis. These task counts are used in the final analysis.

MOS comparability analysis. The primary objective of this final analysis of TCAM is to make recommendations for maintainer MOS actions potentially required by some organizational change. A secondary objective is to describe the major tradeoff issues related to the recommended actions.

In general, MOS comparability is determined by the proportion of the total tasks that are both common and shared by MOSs. If a significant portion of the maintenance tasks required by the systems and currently performed by one MOS are similar to those performed by another MOS in both function and enabling criteria required, then the MOSs should be considered for merger.

MOS Comparability Analysis begins with examination of the data provided by analyses of tasks determined to be required under the organizational change. Additional inputs are equipment descriptions, POIs, and SMEs.

Data in both the Between-Systems analysis and Within-Systems analysis matrices are examined to determine how many required tasks common to all systems are currently shared by MOSs and how many required tasks within systems are currently shared by MOSs. Analysts identify the number of tasks now performed by several MOSs on comparable equipment and requiring comparable knowledge and training. Compared against the total number of required tasks, this number is an indication of the degree of comparability between current MOSs in terms of the new system requirements.

A high proportion of shared tasks is generally indicative of the need for additional, more comprehensive MOS restructuring analysis. However, there can be no simple formula for restructuring MOSs derived from these data. The degree of comparability between MOSs must be balanced against system requirements, training requirements, and many other factors. MOSs that show 40 percent comparability may be excellent candidates for consolidation in one mission context and poor candidates in another. Therefore, the abilities of analysts to interpret these data are important to the success of the process.

The primary output of this analysis is the recommendation whether to initiate formal MOS restructuring analysis.

Recommendations are presented in terms of which MOSs are affected by the decision and the type of MOS action appropriate to meeting the maintenance goals of the stated mission.

Secondary output presents the major tradeoff issues associated with the recommended MOS action. Although tradeoff issues are limited to the scope and the level of detail of the analysis, they provide a mission-oriented framework in which the MOS action can be understood. Furthermore, these tradeoff issues serve to focus the scope and details of subsequent analysis.

<u>**Strengths and Limitations of TCAM**</u>

Development of any analysis model is an iterative process. The BMS case study was both a development tool for TCAM as well as a test of the model's applicability. While application of the model to BMS revealed some shortfalls, TCAM shows promise in meeting its objectives. Both the model's shortfalls and strengths are discussed below.

<u>**TCAM limitations**</u>. The primary limitation of TCAM is common to most, if not all, predictive methods; TCAM relies heavily on SMEs. This reliance occurs at both the data collection and data analysis phases.

Some problems of reliance on SMEs are procedural. In practice, it is difficult to assemble SME panels and collect accurate, reliable data in a timely fashion. Such problems can be dealt with through limiting the number of participants, careful briefing, and the use of techniques that systematize data collection.

Other problems are related to interpretation of the data. Any MOS restructuring recommendation based on data developed by TCAM is necessarily heavily influenced by the mission context. Therefore, the weighting applied to certain categories of tasks must vary from one application of the method to the next, placing a premium on analysts' and SMEs' abilities to prioritize tasks based on mission objectives.

<u>**TCAM's Strengths**</u>. The primary strength of TCAM is its grounding in the requirements generated by organizational change. Expressing equipment systems in terms of the tasks required by the mission and the knowledge required to perform those tasks in the context of that mission ensures that MOS structures are able to support that equipment within that mission.

Also, TCAM provides a means to systematically assess the need for MOS restructuring without initiating the massive analysis process of formal MOS restructuring assessment. While TCAM can accommodate analysis of any number of equipment systems, TCAM can also be applied with few resources using data sources that are readily available.

APPENDIX B

ENABLING CRITERIA

Appendix B

Enabling Criteria

No.	Enabling Criteria	Description
01	Principles of Mechanical Devices and Machines	An understanding of the function and applied principles of mechanical devices such as wheels, pulleys, gears, levers, etc.
02	Knowledge of Shop Math	An understanding of basic mathematics and common measuring tools used in normal maintenance operations.
03	Principles of Fuels, Oils, and Lubricants	An understanding of the safe use, types, handling, and storage of fuels oils and lubricants. Also, an understanding of the implications of contamination.
04	Use of Specialized tools and TMDE	An understanding of the application and care of specialized tools along with testing, precision measuring devices, and diagnostic equipment.
05	Principles of Reciprocating Engines	An understanding of the operating principals of engines to include two-stroke and four-stroke engines, as well as spark ignition and compression ignition engines.
06	Knowledge of Units of Measurement	An understanding of common units of measurement used in maintenance applications.
07	Use and Care of Bearings	An understanding of the care and application of bearings, and the ability to recognize usual bearing failure indicators.
08	Use and Care of Gaskets and Seals	An understanding of the care, fabrication, and use of gaskets and seals, and the ability to recognize common failure indicators.
09	Principles of Basic Electricity and Magnetism	An understanding of basic AC and DC theory, Ohms law, the principles of magnetism, along with reading, interpreting, and using electrical terms, schematics, and diagrams.
10	Principles of Troubleshooting (Electrical)	An understanding of basic electrical troubleshooting logic and techniques to include the use of the multimeter and visual indicators, along with series and parallel circuit problem solving.
11	Principles of Vehicle Charging Systems	An understanding of the name, location, description, and purpose of components in the typical charging system.
12	Principles of Vehicle Electrical Systems	An understanding of the name, location, description, and function of components in vehicle electrical power distribution systems.
13	Principles of Troubleshooting (Mechanical)	An understanding of basic mechanical troubleshooting logic and techniques to include the use of standard test and diagnostic equipment and visual indicators, along with mechanical problem solving.
14	Principles of Track Vehicle Suspension Systems	An understanding of the design and operating principles of tracked vehicle suspension systems.
15	Principles of Wheel Vehicle Suspension Systems	An understanding of the design and operating principles of wheeled vehicle suspension systems.

16	Principles of Vehicle Steering Systems	An understanding of both hydraulic and manual steering systems to include troubleshooting, replacing, servicing, and adjusting components.
17	Principles of Cross-Drive Transmissions	An understanding of the design, operating principles, and functions of components cross drive transmissions.
18	Principles of Drive Line Components (Tracked Vehicles)	An understanding of the design, location, operating principles, and functions of driveline components on track vehicles.
19	Principles of Drive Line Components (Wheeled Vehicles)	An understanding of the design, location, operating principles, and functions of driveline components on wheeled vehicles.
20	Knowledge of Basic Hydraulics	An understanding of basic hydraulics to include the purpose, operating principles, reading and interpreting hydraulic schematic terms, symbols, and diagrams, as well as replacement of basic hydraulic components.
21	Principles of Troubleshooting (Hydraulics)	An understanding of basic hydraulic troubleshooting logic and techniques to include use of visual indicators, along with Hydraulic problem solving.
22	Principles of Brake Systems	An understanding of the design and operating principles of differing brake systems to include Hydraulic, pneumatic, and mechanical brake systems.
23	Principles of Air Induction Systems	An understanding of the operating principles of common air induction systems.
24	Knowledge of Ground Hopping Techniques	An understanding of ground hopping techniques to include the principles and applications of ground hopping kits, as well as field expedient methods for safely performing ground hopping operations.
25	Principles of Gas Turbine Engines	An understanding of the operating principles, description, function, and location of components of gas turbine engines.
26	Principles of Diesel Engines	An understanding of the operating principles, description, and function of components of compression ignition engines.
27	Principles of Spark Ignition Engine Systems	An understanding of the operating principles, description, function, and location of components of spark ignition engines.
28	Knowledge of Basic Soldering Techniques	An understanding of the purpose, care, and use of soldering irons and the function of cutting, stripping, soldering, electrical wiring and connectors.
29	Principles of Fluid Systems (Non Hydraulics)	An understanding principles, description, and location of components such as pumps, plumbing, and fittings of fluid systems other than hydraulics. This includes fuel, water, and oil systems.

APPENDIX C

GUIDELINES FOR ASSIGNING ENABLING CRITERIA TO TASKS

Appendix C

Guidelines for Assigning Enabling Criteria to Tasks

Enabling criteria have been assigned to M1, M2, and M88 maintenance tasks. You will be asked to review these choices and make any corrections you feel are needed, based on your experience. There are three lists to help you with this task:

1. Task action definitions list
2. Enabling criteria definitions list
3. Maintenance task list.

You will verify the accuracy of the enabling criteria that have been assigned to maintenance tasks by following these general guidelines:

1. Base decisions on the definitions of task actions and enabling criteria.

2. Study the task in isolation of other associated tasks. The task should stand alone.

3. If two or more enabling criteria apply to a task, choose those that give the greatest detail.

4. Choose as many enabling criteria as appropriate, given #3.

PROCEDURE:

Review the general steps of performance required by the task. Remember that the task should be thought of as separate from tasks that normally are performed before or after it is performed. Check the list of enabling criteria needed for those steps. If you agree with the selections you may move on to the next task. If you disagree or would like to add new enabling criteria, feel free to make any changes you feel best describe the knowledge and skills needed to perform the task. There is no limit to the number of criteria you choose. However, if there are several enabling criteria that apply, choose the ones that describe the skills required in the most detail rather than the criteria that describe general skills. The following example describes this procedure in more detail.

EXAMPLE:

You are working on a GM 3/4 ton truck with a gasoline engine. Your task is to REPLACE the alternator.

First, look at the definition of REPLACE in the task action definitions list. REPLACE simply means to swap a new alternator for the old one. By the definition, the task does not include any fine adjustment of the alternator's position. Another task, ADJUST or ALIGN, will deal with ensuring proper tensioning of the fan belt.

Second, think about the general steps of performance of the REPLACE task. To swap a new alternator for an old one the general steps are: disconnect electrical cable, remove fan belt, remove retaining bolts, remove alternator. Installing the new alternator involves the same steps in reverse order. Since you will choose the enabling criteria necessary to swap a new alternator with the bad one you do not have to worry about the enabling criteria for testing the alternator to see if it is bad. Also, you can assume that any work needed to get to the alternator has been done already, such as lifting the hood. Finally, assume that standard mechanic's tools are available.

Third, review the general steps of performance of the task then choose enabling criteria that apply to those steps from the list of enabling criteria. One step is to disconnect the electrical cable. Think about what knowledge the maintainer needs to disconnect that cable then find that enabling criteria in the list. (As you have seen from the list of enabling criteria, there is no enabling criteria for general mechanical skills such as removing bolts and the use of hand tools. These skills apply to most of the tasks and it is assumed that all maintainers have these skills.) Ask yourself whether this step requires knowledge of basic electricity, vehicle electrical systems, vehicle charging systems, or even principles of electrical troubleshooting.

Principles of Electrical Troubleshooting is not necessary because the task is to replace, not test or inspect. Principles of Basic Electricity is not necessary because disconnecting the cable involves only pulling the cable connector apart. Two enabling criteria seem to fit the step: Principles of Vehicle Electrical Systems and Principles of Vehicle Charging Systems. Both include an understanding of the name and location of the alternator. Principles of Vehicle Charging Systems describes the steps in more detail because it focuses specifically on components of charging systems, one of which is the alternator.

Review all of the general steps of performance and assign enabling criteria in the same way as for disconnecting the cable. If you have trouble deciding whether to choose an enabling criteria for a task, ask yourself this question: "Is this knowledge or skill important to performing the task?" If you think the answer is yes, choose the enabling criteria.

For example, does a maintainer need an understanding of the principles of mechanical devices and machines to replace the alternator on the truck? Probably not, but if you are not sure, choose it anyway. Would the maintainer need this knowledge to adjust the alternator for optimum performance? The answer for this task would be yes.

APPENDIX D

M1 AND M88 BMS UNIT LEVEL TASKS

Task List Description

Tasks are presented as they appear in the data base. The first columns in the data base are devoted to codes that uniquely identify each task, as well as categorize the task on several dimensions. The next columns contain descriptions of the tasks, identify who currently performs the tasks, and list the enabling criteria requirements of the tasks.

Data in the first column identifies a task as belonging to the M1 or M88 systems. Three columns of task identification numbers follow the system identification. Task numbers with the "999" suffix do not represent actual tasks; they are assembly and subassembly titles for the tasks listed below them.

Data in the remaining columns describe a task. The fifth column contains the maintenance function description such as "INSPECT" or "REPAIR". The next column contains a description of the equipment upon which the task is performed. Columns 7 through 12 represent Crew MOSs and MOSs 63E, 63G, 63H, 63J, 63N, and 63T. The "X" indicates MOSs currently responsible for these tasks. Finally, the remaining columns are devoted to the enabling criteria associated with each task.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
M1	10	0	1	INSPECT	POWERPACK ASSEMBLY		X						1	3	10	11	12	13	17	20	21
M1	10	0	2	TEST	POWERPACK ASSEMBLY		X						1	4	10	11	12	13	17	20	21
M1	10	0	3	SERVICE	POWERPACK ASSEMBLY		X						1	3	4	8	9	10	11	12	17
M1	10	10	1	INSPECT	ENGINE ASSEMBLY		X		X				3	4	10	11	12	13	23	25	29
M1	10	10	3	ADJUST	ENGINE ASSEMBLY				X				1	4	9	11	12	24	25	0	0
M1	10	11	3	REPLACE	GAS COVER AND COMBUSTER ASSEMBLY SPARK IGNITER		X						4	8	25	0	0	0	0	0	0
M1	10	11	5	INSPECT	COMBUSTOR LINER		X						4	8	25	0	0	0	0	0	0
M1	10	11	10	REPLACE	ACCESSORY GEARBOX DRIVE ASSEMBLY		X						1	3	4	8	25	29	0	0	0
M1	10	11	14	INSPECT	LP ROTOR AND HOUSING ASSY				X				1	3	7	8	13	23	25	0	0
M1	10	12	1	REPLACE	TURBINE EXHAUST DUCT		X						8	25	0	0	0	0	0	0	0
M1	10	13	1	REPLACE	REAR ENGINE MODULE				X				8	18	25	0	0	0	0	0	0
M1	10	13	5	REPLACE	REDUCTION GEARBOX				X				8	18	25	0	0	0	0	0	0
M1	10	14	3	REPLACE	GEAR COVER ASSEMBLY				X				1	8	25	0	0	0	0	0	0
M1	10	14	5	REPLACE	OIL RETAINER				X				8	25	0	0	0	0	0	0	0
M1	10	14	6	REPAIR	OIL RETAINER				X				3	8	25	29	0	0	0	0	0
M1	10	21	1	SERVICE	MAIN FUEL CONTROL		X						3	8	20	24	25	29	0	0	0
M1	10	21	2	REPLACE	MAIN FUEL CONTROL			X					3	8	29	0	0	0	0	0	0
M1	10	21	4	SERVICE	FUEL INJECTION NOZZLE (1 AND 2 PIECE)			X					3	8	24	25	29	0	0	0	0
M1	10	21	15	REPAIR	PTS FE CONTROL ASSEMBLY			X					3	9	25	29	0	0	0	0	0
M1	10	25	8	SERVICE	RIGHT ENGINE COMPARTMENT FUEL TANK		X						3	4	8	9	12	29	0	0	0
M1	10	25	11	INSPECT	ENGINE FUEL TANK, RIGHT SPONSON		X						8	9	12	13	29	0	0	0	0
M1	10	25	12	SERVICE	ENGINE FUEL TANK, RIGHT SPONSON		X						3	4	8	9	12	29	0	0	0
M1	10	25	15	INSPECT	ENGINE FUEL TANK, LEFT SPONSON		X						8	9	12	13	29	0	0	0	0
M1	10	25	16	SERVICE	ENGINE FUEL TANK, LEFT SPONSON		X						3	4	8	9	12	29	0	0	0
M1	10	31	5	REPLACE	FRICTION CLUTCH		X						4	17	0	0	0	0	0	0	0
M1	10	31	8	REPLACE	DOUBLE UNIVERSAL PROPELLER SHAFT		X						17	0	0	0	0	0	0	0	0
M1	10	31	10	REPLACE	QUILL SHAFT ASSEMBLY		X						17	0	0	0	0	0	0	0	0
M1	10	31	17	REPLACE	DOUBLE UNIVERSAL PROPELLER SHAFT		X						17	0	0	0	0	0	0	0	0
M1	10	41	1	REPLACE	GENERATOR		X						1	3	8	9	11	12	0	0	0
M1	10	41	1	REPLACE	GENERATOR REGULATOR (VOLTAGE REGULATOR)		X						9	11	12	0	0	0	0	0	0
M1	10	42	1	REPLACE	STARTING MOTOR		X						8	9	11	12	0	0	0	0	0
M1	10	42	5	REPLACE	SHIFT HOUSING			X					4	9	11	12	0	0	0	0	0
M1	10	42	9	REPLACE	ELECTROMAGNETIC RELAY		X						9	11	12	0	0	0	0	0	0
M1	10	42	11	REPLACE	ELECTRICAL SOLENOID		X						9	11	12	0	0	0	0	0	0
M1	10	46	1	REPLACE	WIRING HARNESS		X						4	9	12	28	0	0	0	0	0
M1	10	46	3	REPLACE	BRANCHED WIRING HARNESS		X						4	9	12	28	0	0	0	0	0
M1	10	49	21	REPAIR	INTERCONNECTING BOX			X					4	9	12	28	0	0	0	0	0
M1	10	49	28	REPLACE	HNB CIRCUIT CARD ASSY (A1-A4)			X					4	9	12	0	0	0	0	0	0
M1	10	51	1	REPLACE	MODULATOR VALVE		X						3	8	12	17	29	0	0	0	0
M1	10	51	4	REPLACE	OIL COVER ASSY		X						3	8	17	0	0	0	0	0	0
M1	10	51	6	REPLACE	OIL COVER ASSY		X						3	8	17	0	0	0	0	0	0
M1	10	51	7	REPLACE	FLUID FILTER BODY		X						3	8	17	0	0	0	0	0	0
M1	10	52	1	INSPECT	TRANSMISSION CROSS DRIVE	X							3	17	18	20	21	22	24	0	0
M1	10	52	2	SERVICE	TRANSMISSION CROSS DRIVE		X						3	4	8	17	18	20	24	0	0

M1	10	52	3	ADJUST	TRANSMISSION CROSS DRIVE		X		3	4	8	17	18	22	24	0	0
M1	10	55	1	REPLACE	STEERING COVER HOUSING		X		3	4	8	17	0	0	0	0	0
M1	10	55	3	REPLACE	LEFT HAND BRAKE COVER ASSY		X		3	4	8	17	0	0	0	0	0
M1	10	60	1	INSPECT	FINAL DRIVE ASSY	X	X		3	18	0	0	0	0	0	0	0
M1	10	60	2	SERVICE	FINAL DRIVE ASSY		X		3	18	0	0	0	0	0	0	0
M1	10	72	1	SERVICE	LUBRICATING OIL TANK	X	X		8	29	0	0	0	0	0	0	0
M1	10	72	4	REPLACE	FILLER OPENING CAP		X		3	8	29	0	0	0	0	0	0
M1	10	73	1	REPLACE	LUBRICATING COOLER		X		3	8	29	0	0	0	0	0	0
M1	30	10	1	INSPECT	SOLID RUBBER WHEEL	X			13	14	0	0	0	0	0	0	0
M1	30	10	2	REPLACE	SOLID RUBBER WHEEL		X		14	0	0	0	0	0	0	0	0
M1	30	31	1	INSPECT	TRACK ASSY	X			13	14	0	0	0	0	0	0	0
M1	30	31	2	REPLACE	TRACK ASSY		X		14	0	0	0	0	0	0	0	0
M1	30	31	4	INSPECT	TRACK SHOE ASSY	X		X	14	0	0	0	0	0	0	0	0
M1	30	31	5	REPLACE	TRACK SHOE ASSY		X		18	0	0	0	0	0	0	0	0
M1	30	32	1	INSPECT	SUPPORT ROLLER ASSY	X			18	0	0	0	0	0	0	0	0
M1	30	32	2	SERVICE	SUPPORT ROLLER ASSY		X		18	0	0	0	0	0	0	0	0
M1	30	33	1	INSPECT	HUB AND ARM ASSY	X			18	0	0	0	0	0	0	0	0
M1	30	33	2	SERVICE	HUB AND ARM ASSY		X		18	0	0	0	0	0	0	0	0
M1	30	33	3	REPLACE	HUB AND ARM ASSY		X		18	0	0	0	0	0	0	0	0
M1	30	33	5	REPLACE	WHEEL HUB ASSY		X		18	0	0	0	0	0	0	0	0
M1	30	33	9	INSPECT	LEFT AND RIGHT TRACK ADJUSTING LINK	X			18	0	0	0	0	0	0	0	0
M1	30	33	11	SERVICE	LEFT AND RIGHT TRACK ADJUSTING LINK		X		18	0	0	0	0	0	0	0	0
M1	30	33	12	REPLACE	LEFT AND RIGHT TRACK ADJUSTING LINK		X		18	0	0	0	0	0	0	0	0
M1	30	33	13	REPAIR	LEFT AND RIGHT TRACK ADJUSTING LINK		X		3	4	14	0	0	0	0	0	0
M1	30	34	1	INSPECT	TRACK DRIVE SPROCKET WHEEL	X			18	0	0	0	0	0	0	0	0
M1	30	40	7	INSPECT	HUB AND ARM ASSY (POSITION 1)	X			8	14	0	0	0	0	0	0	0
M1	30	40	8	SERVICE	HUB AND ARM ASSY (POSITION 1)		X		8	14	0	0	0	0	0	0	0
M1	30	40	11	INSPECT	HUB AND ARM ASSY (POSITIONS 2 AND 7)	X			8	14	0	0	0	0	0	0	0
M1	30	40	12	SERVICE	HUB AND ARM ASSY (POSITIONS 2 AND 7)		X		8	14	0	0	0	0	0	0	0
M1	30	40	21	INSPECT	HUB AND ARM ASSEMBLY (POSITIONS 3-6)	X			8	14	0	0	0	0	0	0	0
M1	30	40	22	SERVICE	HUB AND ARM ASSEMBLY (POSITIONS 3-6)		X		8	14	0	0	0	0	0	0	0
M1	40	10	1	ADJUST	THROTTLE STEERING ASSY		X		4	16	24	0	0	0	0	0	0
M1	40	10	7	REPAIR	ROTARY AND LEVER ASSY		X		28	0	0	0	0	0	0	0	0

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
M88	10	0	1	INSPECT	POWER PLANT		X		X		X	X	1	3	10	11	12	13	17	21	26
M88	10	0	2	TEST	POWER PLANT		X		X		X	X	1	4	10	12	13	17	22	23	24
M88	10	0	3	SERVICE	POWER PLANT		X		X		X	X	1	4	8	9	12	17	18	25	26
M88	10	0	4	ADJUST	POWER PLANT		X		X		X	X	4	13	17	18	24	26	0	0	0
M88	10	10	1	INSPECT	DIESEL ENGINE				X				3	10	11	12	13	17	23	26	29
M88	10	10	2	TEST	DIESEL ENGINE				X				4	13	24	26	0	0	0	0	0
M88	10	10	3	ADJUST	DIESEL ENGINE				X				1	9	11	12	24	26	0	0	0
M88	10	21	1	INSPECT	FUEL INJECTION PUMP			X	X				3	8	9	13	29	0	0	0	0
M88	10	21	3	INSPECT	FUEL INJECTION LINES		X	X	X		X	X	3	8	13	29	0	0	0	0	0
M88	10	21	5	INSPECT	FUEL INJECTOR NOZZLE AND HOLDER ASSY			X	X				3	8	13	29	0	0	0	0	0
M88	10	21	6	TEST	FUEL INJECTOR NOZZLE AND HOLDER ASSY			X					3	4	8	13	29	0	0	0	0
M88	10	21	7	ADJUST	FUEL INJECTOR NOZZLE AND HOLDER ASSY			X	X				3	4	8	29	0	0	0	0	0
M88	10	22	6	INSPECT	ENGINE FUEL PUMP		X		X		X	X	3	8	10	13	29	0	0	0	0
M88	10	22	7	TEST	ENGINE FUEL PUMP		X		X		X	X	3	13	26	29	0	0	0	0	0
M88	10	22	11	INSPECT	FUEL TANK FUEL PUMP		X		X		X	X	3	8	13	29	0	0	0	0	0
M88	10	22	14	INSPECT	PURGE PUMP		X	X	X		X	X	3	8	13	29	0	0	0	0	0
M88	10	22	15	TEST	PURGE PUMP		X	X	X		X	X	3	8	13	29	0	0	0	0	0
M88	10	24	1	INSPECT	DIESEL TURBOSUPERCHARGER		X		X		X	X	1	8	13	18	23	26	29	0	0
M88	10	25	1	INSPECT	FUEL TANK	X	X		X				3	8	13	29	0	0	0	0	0
M88	10	25	2	SERVICE	FUEL TANK	X	X		X		X	X	3	8	29	0	0	0	0	0	0
M88	10	25	3	REPLACE	FUEL TANK				X				3	8	29	0	0	0	0	0	0
M88	10	25	5	INSPECT	FORWARD FUEL TANK				X				3	8	13	29	0	0	0	0	0
M88	10	25	6	SERVICE	FORWARD FUEL TANK		X		X		X	X	3	8	29	0	0	0	0	0	0
M88	10	25	7	INSPECT	LEFT REAR FUEL TANK				X				3	8	13	29	0	0	0	0	0
M88	10	25	8	SERVICE	LEFT REAR FUEL TANK		X		X		X	X	3	8	29	0	0	0	0	0	0
M88	10	26	9	INSPECT	FUEL/WATER SEPARATOR FILTER ASSY		X		X		X	X	0	0	0	0	0	0	0	0	0
M88	10	26	10	SERVICE	FUEL/WATER SEPARATOR FILTER ASSY		X		X		X	X	0	0	0	0	0	0	0	0	0
M88	10	26	11	REPLACE	FUEL/WATER SEPARATOR FILTER ASSY		X		X		X	X	0	0	0	0	0	0	0	0	0
M88	10	27	1	INSPECT	PIPES AND ELBOWS		X		X		X	X	3	8	13	29	0	0	0	0	0
M88	10	27	2	REPLACE	PIPES AND ELBOWS		X		X		X	X	8	29	0	0	0	0	0	0	0
M88	10	28	1	INSPECT	ACCELERATOR AND THROTTLE CONTROLS AND LINKAGE		X		X		X	X	1	13	26	0	0	0	0	0	0
M88	10	28.	2	ADJUST	ACCELERATOR AND THROTTLE CONTROLS AND LINKAGE		X		X		X	X	1	26	0	0	0	0	0	0	0
M88	10	28	5	INSPECT	THROTTLE CONTROL ASSY		X		X		X	X	13	26	0	0	0	0	0	0	0
M88	10	28	6	ADJUST	THROTTLE CONTROL ASSY		X		X		X	X	4	26	0	0	0	0	0	0	0
M88	10	28	7	REPLACE	THROTTLE CONTROL ASSY		X		X		X	X	4	26	0	0	0	0	0	0	0
M88	10	28	8	INSPECT	THROTTLE CONTROL SOLENOID ASSY		X		X		X	X	8	9	10	11	13	0	0	0	0
M88	10	29	1	INSPECT	MANIFOLD HEATER NOZZLE AND HOLDER ASSY		X		X		X	X	3	13	29	0	0	0	0	0	0
M88	10	29	2	SERVICE	MANIFOLD HEATER NOZZLE AND HOLDER ASSY		X		X		X	X	3	29	0	0	0	0	0	0	0
M88	10	29	3	REPLACE	MANIFOLD HEATER NOZZLE AND HOLDER ASSY		X		X		X	X	3	29	0	0	C	0	0	0	0
M88	10	29	5	INSPECT	MANIFOLD HEATER IGNITION PLUG		X		X		X	[illegible]	3	9	0	0	0	0	0	0	0
M88	10	29	6	SERVICE	MANIFOLD HEATER IGNITION PLUG		X		X		X		3	9	0	0	0	0	0	0	0
M88	10	29	7	REPLACE	MANIFOLD HEATER IGNITION PLUG		X		X		X	X	3	9	0	0	0	0	0	0	0

M88 10 30	1 INSPECT	ENGINE COOLING FAN AND MANIFOLD SHROUD	X		X	X	X	8	13	0	0	0	0	0	0	0
M88 10 30	2 REPLACE	ENGINE COOLING FAN AND MANIFOLD SHROUD	X		X	X	X	8	0	0	0	0	0	0	0	0
M88 10 30	4 INSPECT	MECHANICAL COOLING HOUSING	X		X	X	X	8	13	0	0	0	0	0	0	0
M88 10 30	5 TEST	MECHANICAL COOLING HOUSING	X		X	X	X	4	13	0	0	0	0	0	0	0
M88 10 30	6 INSPECT	FAN TOWER ASSY	X		X	X	X	8	13	0	0	0	0	0	0	0
M88 10 30	7 TEST	FAN TOWER ASSY	X		X	X	X	4	8	13	0	0	0	0	0	0
M88 10 41	1 INSPECT	ENGINE ACCESSORY GENERATOR	X		X	X	X	9	10	11	12	13	0	0	0	0
M88 10 41	2 TEST	ENGINE ACCESSORY GENERATOR	X		X	X	X	4	9	10	11	12	13	0	0	0
M88 10 41	5 INSPECT	GENERATOR AND GEN AIR AIR EXHAUST PIPE						9	11	12	0	0	0	0	0	0
M88 10 41	6 REPLACE	GENERATOR AND GEN AIR AIR EXHAUST PIPE	X		X	X	X	9	11	12	0	0	0	0	0	0
M88 10 41	7 INSPECT	INTAKE TUBES	X		X	X	X	9	11	13	0	0	0	0	0	0
M88 10 42	1 INSPECT	STARTING MOTOR	X		X	X	X	9	10	11	12	13	0	0	0	0
M88 10 42	2 TEST	STARTING MOTOR	X		X	X	X	4	9	10	11	12	13	0	0	0
M88 10 42	5 INSPECT	WATERPROOF SWITCHING RELAY BOX ASSY	X		X	X	X	9	10	12	0	0	0	0	0	0
M88 10 42	6 TEST	WATERPROOF SWITCHING RELAY BOX ASSY	X			X	X	4	9	10	11	12	13	0	0	0
M88 10 42	7 ADJUST	WATERPROOF SWITCHING RELAY BOX ASSY	X		X	X	X	4	9	11	12	0	0	0	0	0
M88 10 42	8 REPLACE	WATERPROOF SWITCHING RELAY BOX ASSY	X		X	X	X	4	9	11	12	0	0	0	0	0
M88 10 42	10 INSPECT	STARTER RELAY SOLENOID	X		X	X	X	9	10	11	12	13	0	0	0	0
M88 10 42	11 TEST	STARTER RELAY SOLENOID	X		X	X	X	4	9	10	11	12	13	0	0	0
M88 10 44	1 TEST	WARNING SWITCHES	X	X	X	X	X	4	9	10	11	12	13	0	0	0
M88 10 44	4 TEST	SENDING UNITS	X	X	X	X	X	4	9	10	12	13	0	0	0	0
M88 10 44	5 REPLACE	SENDING UNITS	X		X	X	X	9	12	28	0	0	0	0	0	0
M88 10 44	6 INSPECT	PROT SYS LOW VOLTAGE RELAY SOLENOID	X		X	X	X	9	11	12	0	0	0	0	0	0
M88 10 44	7 TEST	PROT SYS LOW VOLTAGE RELAY SOLENOID	X		X	X	X	4	9	10	11	12	13	0	0	0
M88 10 45	1 INSPECT	BATTERY	X		X	X	X	9	11	13	0	0	0	0	0	0
M88 10 45	2 TEST	BATTERY	X		X	X	X	4	9	10	11	12	13	0	0	0
M88 10 45	3 SERVICE	BATTERY	X		X	X	X	3	9	11	12	0	0	0	0	0
M88 10 45	4 REPLACE	BATTERY	X		X	X	X	9	11	12	0	0	0	0	0	0
M88 10 45	5 INSPECT	BATTERY BOX	X		X	X	X	9	10	11	12	13	0	0	0	0
M88 10 45	6 SERVICE	BATTERY BOX	X		X	X	X	9	11	12	0	0	0	0	0	0
M88 10 45	7 REPLACE	BATTERY BOX			X			9	12	0	0	0	0	0	0	0
M88 10 46	1 INSPECT	HULL WIRING HARNESS ASSEMBLIES	X		X	X	X	9	10	11	12	13	0	0	0	0
M88 10 46	2 TEST	HULL WIRING HARNESS ASSEMBLIES	X		X	X	X	4	9	10	11	12	13	0	0	0
M88 10 46	5 INSPECT	BILGE PUMP LEAD RELAY WIRING HARNESS	X		X	X	X	9	10	11	12	13	0	0	0	0
M88 10 46	8 INSPECT	BILGE PUMP CKT BKR-TO-SWITCH PANEL LEAD	X		X	X	X	9	10	11	12	13	0	0	0	0
M88 10 46	11 INSPECT	ACCESSORIES CABLE ASSY	X		X	X	X	4	9	10	11	12	13	0	0	0
M88 10 46	12 TEST	ACCESSORIES CABLE ASSY	X		X	X	X	4	9	10	11	12	13	0	0	0
M88 10 46	15 INSPECT	ENGINE ELECTRICAL INSTALLATION	X		X	X	X	9	10	11	12	13	0	0	0	0
M88 10 46	16 TEST	ENGINE ELECTRICAL INSTALLATION	X		X	X	X	4	9	10	11	12	13	0	0	0
M88 10 51	8 TEST	LUBE AND CONVERTER REGULATOR COOLER BYPASS	X	X	X	X	X	3	4	13	17	29	0	0	0	0
M88 30 33	1 SERVICE	ARM, ROADWHEEL ASSY	X		X	X	X	3	18	0	0	0	0	0	0	0
M88 30 33	4 REPAIR	ARM, ROADWHEEL ASSY	X		X	X	X	1	3	4	14	30	0	0	0	0
M88 30 20	1 INSPECT	DRIVE SPROCKET	X		X	X	X	13	14	18	0	0	0	0	0	0
M88 30 20	2 REPLACE	DRIVE SPROCKET	X		X	X	X	4	18	0	0	0	0	0	0	0
M88 30 31	1 INSPECT	TRACK ASSY	X		X	X	X	13	14	18	0	0	0	0	0	0

M88 30 31	2 ADJUST	TRACK ASSY	X		X	X	X	14	18	0	0	0	0	0	0	0
M88 30 31	3 REPLACE	TRACK ASSY	X		X	X	X	14	18	0	0	0	0	0	0	0
M88 30 31	4 REPAIR	TRACK ASSY	X		X	X	X	4	14	0	0	0	0	0	0	0
M88 30 31	5 REPLACE	SHOE ASSY	X		X	X	X	4	18	0	0	0	0	0	0	0
M88 30 40	1 INSPECT	BUMPER ASSY	X		X	X	X	13	14	0	0	0	0	0	0	0
M88 30 50	1 SERVICE	BRAKE CONTROLS AND LINKAGES	X		X	X	X	3	8	22	0	0	0	0	0	0
M88 30 50	2 INSPECT	BRAKE CONTROLS AND LINKAGES	X		X	X	X	13	22	0	0	0	0	0	0	0
M88 30 50	3 ADJUST	BRAKE CONTROLS AND LINKAGES	X		X	X	X	22	0	0	0	0	0	0	0	0
M88 30 50	5 REPAIR	BRAKE CONTROLS AND LINKAGES	X		X	X	X	1	3	4	8	17	18	21	22	0
M88 40 10	1 INSPECT	STEERING AND SHIFTING CONTROLS	X		X	X	X	13	16	17	0	0	0	0	0	0
M88 41 10	2 TEST	STEERING AND SHIFTING CONTROLS	X		X	X	X	16	17	0	0	0	0	0	0	0
M88 40 10	3 ADJUST	STEERING AND SHIFTING CONTROLS	X		X	X	X	16	17	0	0	0	0	0	0	0
M88 40 10	5 REPAIR	STEERING AND SHIFTING CONTROLS	X		X	X	X	1	16	17	18	0	0	0	0	0
M88 60 10	11 REPAIR	PERISCOPE AND VISION PRISM	X		X	X	X	8	0	0	0	0	0	0	0	0
M88 60 20	4 REPAIR	DRAIN VALVES	X		X	X	X	1	29	0	0	0	0	0	0	0
M88 70 0	10 REPAIR	HOIST WINCH WIRE ROPE ASSY			X			1	4	0	0	0	0	0	0	0
M88 70 0	13 REPAIR	HOIST AND MAIN WINCH BRAKE BAND ASSY			X			1	3	4	8	20	0	0	0	0
M88 70 0	17 REPAIR	MAIN WINCH CABLE ASSY			X			1	4	0	0	0	0	0	0	0
M88 70 0	18 TEST	MAIN AND HOIST WINCH BRAKE CYLINDER			X			4	13	22	0	0	0	0	0	0
M88 70 0	27 REPAIR	MAIN WINCH LEVEL WINDER ARM ASSY			X			1	4	0	0	0	0	0	0	0
M88 70 0	34 REPAIR	PROP SHAFT WITH UNIVERSAL JOINT ASSY			X			1	0	0	0	0	0	0	0	0
M88 70 0	40 REPAIR	TRANSMISSION OIL COOLER ASSY			X			3	8	29	30	0	0	0	0	0
M88 70 0	42 REPAIR	HOIST BOOM			X			1	4	0	0	0	0	0	0	0
M88 80 20	4 REPAIR	HYDRAULIC TANK ASSY			X			1	3	8	29	30	0	0	0	0
M88 80 20	11 REPAIR	AUXILLIARY POWER UNIT ASSY			X			3	4	5	8	11	18	20	23	26
M88 80 20	21 REPAIR	OIL COOLER ASSY			X			3	26	29	30	0	0	0	0	0
M88 80 20	25 REPAIR	FUEL INJECTION PUMP ASSY		X				1	3	4	8	26	29	0	0	0
M88 80 20	28 REPAIR	FUEL TRANSFER PUMP ASSY		X				1	3	4	8	9	29	0	0	0
M88 80 20	32 INSPECT	FILTER ELEMENT AIR CLEANER LINES	X		X	X	X	29	0	0	0	0	0	0	0	0
M88 80 20	33 SERVICE	FILTER ELEMENT AIR CLEANER LINES	X		X	X	X	29	0	0	0	0	0	0	0	0
M88 80 20	34 REPLACE	FILTER ELEMENT AIR CLEANER LINES	X		X	X	X	29	0	0	0	0	0	0	0	0
M88 80 20	44 REPAIR	GENERATOR/STARTER (COMBINATION)		X				4	9	11	12	18	28	0	0	0
M88 80 20	46 REPAIR	APU ELECTRIC WIRING		X				4	9	12	0	0	0	0	0	0
M88 80 20	49 REPAIR	FUEL SHUTOFF SOLENOID PLUNGER ASSY		X				4	9	12	29	0	0	0	0	0
M88 80 40	3 REPAIR	FIRE FIGHTING EQUIPMENT CONTROLS	X		X	X	X	29	0	0	0	0	0	0	0	0

APPENDIX E

M1 AND M88 BMS FIELD REPAIR LEVEL TASKS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
M1	10	0	4	REMOVE	POWERPACK ASSEMBLY		X						1	4	8	12	18	0	0	0	0
M1	10	0	5	INSTALL	POWERPACK ASSEMBLY		X						1	4	8	12	18	24	0	0	0
M1	10	0	6	REPLACE	POWERPACK ASSEMBLY		X						3	4	8	12	0	0	0	0	0
M1	10	0	7	REPAIR	POWERPACK ASSEMBLY		X		X				3	4	6	8	17	20	22	23	25
M1	10	10	4	REPLACE	ENGINE ASSEMBLY				X				4	7	8	18	24	0	0	0	0
M1	10	10	5	REPAIR	ENGINE ASSEMBLY		X		X				3	4	6	8	18	23	25	29	0
M1	10	10	7	REPAIR	COUPLING CLAMP		X						17	18	25	0	0	0	0	0	0
M1	10	11	1	REPLACE	FORWARD ENGINE MODULE				X				1	3	4	8	18	25	0	0	0
M1	10	11	2	REPAIR	FORWARD ENGINE MODULE		X						1	4	7	8	23	25	0	0	0
M1	10	11	4	REPAIR	GAS COVER AND COMBUSTER ASSEMBLY SPARK IGNITER				X				8	25	27	29	0	0	0	0	0
M1	10	11	6	REPLACE	COMBUSTOR LINER		X						4	8	25	0	0	0	0	0	0
M1	10	11	7	REPLACE	IGV AND BLEED ACTUATOR		X						4	8	25	29	0	0	0	0	0
M1	10	11	8	ADJUST	IGV AND BLEED ACTUATOR		X						4	25	29	0	0	0	0	0	0
M1	10	11	11	REPLACE	AIR-BLEED BUTTERFLY VALVE		X						4	8	0	0	0	0	0	0	0
M1	10	11	12	REPLACE	METAL GRILLE		X						4	25	0	0	0	0	0	0	0
M1	10	12	2	REPAIR	TURBINE EXHAUST DUCT		X						8	25	0	0	0	0	0	0	0
M1	10	13	2	REPAIR	REAR ENGINE MODULE				X				4	8	18	25	29	0	0	0	0
M1	10	13	3	REPLACE	REAR ENGINE SUBASSEMBLY				X				8	18	25	0	0	0	0	0	0
M1	10	13	4	REPAIR	REAR ENGINE SUBASSEMBLY				X				4	8	25	0	0	0	0	0	0
M1	10	13	6	REPAIR	REDUCTION GEARBOX				X				4	8	8	25	29	0	0	0	0
M1	10	14	1	REPLACE	ACCESSORY GEARBOX DRIVE ASSY				X				1	3	7	8	18	25	0	0	0
M1	10	14	4	REPAIR	GEAR COVER ASSEMBLY				X				8	25	29	0	0	0	0	0	0
M1	10	21	3	REPAIR	MAIN FUEL CONTROL			X					4	8	9	20	25	28	29	0	0
M1	10	21	5	REPLACE	FUEL INJECTION NOZZLE (1 AND 2 PIECE)			X					3	8	29	0	0	0	0	0	0
M1	10	21	14	REPLACE	PTS FE CONTROL ASSEMBLY			X					3	4	8	9	29	0	0	0	0
M1	10	21	16	REPLACE	IGV FE CONTROL ASSEMBLY			X					3	4	8	9	29	0	0	0	0
M1	10	21	17	REPAIR	IGV FE CONTROL ASSEMBLY			X					3	9	25	29	0	0	0	0	0
M1	10	22	3	REPAIR	PUMP AND MANIFOLD ASSEMBLY			X					3	4	12	20	21	25	29	0	0
M1	10	25	2	REPAIR	LEFT FORWARD ENGINE FUEL TANK		X						4	8	25	29	0	0	0	0	0
M1	10	25	4	REPAIR	RIGHT FORWARD ENGINE FUEL TANK		X						4	8	25	29	0	0	0	0	0
M1	10	25	6	REPLACE	LEFT ENGINE COMPARTMENT FUEL TANK		X						1	8	9	29	0	0	0	0	0
M1	10	25	7	REPAIR	LEFT ENGINE COMPARTMENT FUEL TANK		X						8	25	29	0	0	0	0	0	0
M1	10	25	9	REPLACE	RIGHT ENGINE COMPARTMENT FUEL TANK		X						1	8	9	29	0	0	0	0	0
M1	10	25	10	REPAIR	RIGHT ENGINE COMPARTMENT FUEL TANK		X						8	25	29	0	0	0	0	0	0
M1	10	25	13	REPLACE	ENGINE FUEL TANK, RIGHT SPONSON		X						1	8	9	29	0	0	0	0	0
M1	10	25	14	REPAIR	ENGINE FUEL TANK, RIGHT SPONSON		X						8	25	29	0	0	0	0	0	0
M1	10	25	17	REPLACE	ENGINE FUEL TANK, LEFT SPONSON		X						1	8	9	29	0	0	0	0	0
M1	10	25	18	REPAIR	ENGINE FUEL TANK, LEFT SPONSON		X						8	25	29	0	0	0	0	0	0
M1	10	25	19	REPLACE	FORWARD FUEL TANK COVER ASSEMBLY		X						8	29	30	0	0	0	0	0	0
M1	10	25	20	REPAIR	FORWARD FUEL TANK COVER ASSEMBLY		X						4	8	30	0	0	0	0	0	0
M1	10	25	21	REPLACE	SPONSON FUEL TANK COVER		X						8	29	30	0	0	0	0	0	0
M1	10	25	22	REPAIR	SPONSON FUEL TANK COVER		X						4	8	30	0	0	0	0	0	0
M1	10	26	4	REPAIR	LIQUID WATER SEPARATOR		X						3	4	8	29	0	0	0	0	0

M1	10 31	1	REPLACE	TRANSMISSION FAN AND DRIVE UNIT (LEFT)	X			1	3	8	17	18	29	0	0	0
M1	10 31	2	REPAIR	TRANSMISSION FAN AND DRIVE UNIT (LEFT)	X		X	4	8	14	29	0	0	0	0	0
M1	10 31	6	REPLACE	ACCESSORY DRIVE GEARBOX	X			1	8	17	29	0	0	0	0	0
M1	10 31	7	REPLACE	ANGLE GEARBOX ASSY DRIVE UNIT	X			17	0	0	0	0	0	0	0	0
M1	10 31	9	REPAIR	DOUBLE UNIVERSAL PROPELLER SHAFT	X			7	14	17	0	0	0	0	0	0
M1	10 31	11	REPAIR	QUILL SHAFT ASSEMBLY	X			7	17	0	0	0	0	0	0	0
M1	10 31	12	REPLACE	RIGHT TRANSMISSION OIL FAN	X			1	3	8	17	18	29	0	0	0
M1	10 31	15	REPLACE	FRICTION CLUTCH	X			4	17	0	0	0	0	0	0	0
M1	10 31	16	REPLACE	ANGLE GEARBOX ASSY DRIVE UNIT	X			8	17	0	0	0	0	0	0	0
M1	10 31	18	REPAIR	DOUBLE UNIVERSAL PROPELLER SHAFT	X			7	17	0	0	0	0	0	0	0
M1	10 41	2	REPAIR	GENERATOR		X		3	4	8	9	11	28	29	0	0
M1	10 42	2	REPAIR	STARTING MOTOR		X		4	9	11	12	18	28	0	0	0
M1	10 42	3	REPLACE	ARMATURE ASSY		X		4	9	11	12	0	0	0	0	0
M1	10 42	4	REPAIR	ARMATURE ASSY		X		4	8	9	11	12	28	0	0	0
M1	10 42	6	REPAIR	SHIFT HOUSING		X		12	28	0	0	0	0	0	0	0
M1	10 42	7	REPLACE	HOUSING ASSY		X		4	9	11	12	0	0	0	0	0
M1	10 42	8	REPAIR	HOUSING ASSY		X		12	0	0	0	0	0	0	0	0
M1	10 42	10	REPAIR	ELECTROMAGNETIC RELAY		X		9	11	12	28	0	0	0	0	0
M1	10 42	12	REPAIR	ELECTRICAL SOLENOID		X		9	11	12	28	0	0	0	0	0
M1	10 44	3	REPAIR	DRIVER'S INSTRUMENT PANEL		X		4	8	9	12	28	0	0	0	0
M1	10 44	4	REPLACE	CIRCUIT CARD ASSEMBLY (A1,A2,A3)		X		4	8	9	12	28	0	0	0	0
M1	10 44	5	REPLACE	CIRCUIT CARD ASSY (A4)		X		4	8	9	12	28	0	0	0	0
M1	10 44	6	REPLACE	DRIVER'S MASTER POWER DISTRIBUTION PANEL		X		8	9	11	12	0	0	0	0	0
M1	10 44	7	REPAIR	DRIVER'S MASTER POWER DISTRIBUTION PANEL		X		4	8	9	12	28	0	0	0	0
M1	10 44	9	REPAIR	DRIVER'S ALERT PANEL		X		4	8	9	12	28	0	0	0	0
M1	10 45	5	REPAIR	STORAGE BATTERY		X		3	4	9	11	28	0	0	0	0
M1	10 46	2	REPAIR	WIRING HARNESS		X		4	8	9	12	28	0	0	0	0
M1	10 46	4	REPAIR	BRANCHED WIRING HARNESS		X		4	8	9	12	28	0	0	0	0
M1	10 49	2	REPAIR	ELECTRONIC CONTROL UNIT		X		4	8	9	12	28	0	0	0	0
M1	10 49	5	REPLACE	PRINTED WIRING BOARD SUPPORT		X		4	9	12	0	0	0	0	0	0
M1	10 49	6	REPAIR	PRINTED WIRING BOARD SUPPORT		X		4	9	12	28	0	0	0	0	0
M1	10 49	7	REPLACE	ECU MODULE ASSY		X		4	9	12	0	0	0	0	0	0
M1	10 49	8	REPAIR	ECU MODULE ASSY		X		4	9	12	28	0	0	0	0	0
M1	10 49	9	REPLACE	MODULATOR-OSCILLATOR		X		4	9	12	0	0	0	0	0	0
M1	10 49	10	REPLACE	CIRCUIT CARD ASSY (A1A2)		X		4	9	12	0	0	0	0	0	0
M1	10 49	11	REPLACE	CIRCUIT CARD ASSY (A2A1)		X		4	9	12	0	0	0	0	0	0
M1	10 49	12	REPLACE	CIRCUIT CARD ASSY (A2A2)		X		4	9	12	0	0	0	0	0	0
M1	10 49	13	REPLACE	MODULATOR-OSCILLATOR (A3A1)		X		4	9	12	0	0	0	0	0	0
M1	10 49	14	REPLACE	MODULATOR-OSCILLATOR (A3A2)		X		4	9	12	0	0	0	0	0	0
M1	10 49	15	REPLACE	MODULATOR-POWER SUPPLY		X		4	9	12	0	0	0	0	0	0
M1	10 49	16	INSPECT	RELAY BOX ASSY (PPI)	X	X		4	9	12	28	0	0	0	0	0
M1	10 49	17	REPLACE	RELAY BOX ASSY (PPI)		X		4	9	12	28	0	0	0	0	0
M1	10 49	18	REPAIR	RELAY BOX ASSY (PPI)		X		4	9	12	28	0	0	0	0	0
M1	10 49	19	REPLACE	CONNECTOR COVER ASSY		X		4	9	12	28	0	0	0	0	0
M1	10 49	20	REPLACE	INTERCONNECTING BOX		X		4	9	12	28	0	0	0	0	0
M1	10 49	22	REPLACE	HULL POWER DISTRIBUTION BOX		X		9	11	12	0	0	0	0	0	0
M1	10 49	23	REPAIR	HULL POWER DISTRIBUTION BOX		X		4	8	9	12	28	0	0	0	0
M1	10 49	24	REPLACE	HULL NETWORKS DISTRIBUTION BOX		X		9	11	12	0	0	0	0	0	0
M1	10 49	25	REPAIR	HULL NETWORKS DISTRIBUTION BOX		X		4	8	9	12	28	0	0	0	0
M1	10 51	1	REPAIR	DIFFERENTIAL GEAR UNIT			X	3	4	17	0	0	0	0	0	0
M1	10 51	1	SERVICE	PRESSURE FLUID FILTER	X			3	8	17	29	0	0	0	0	0

M1	10	51	2 REPLACE	FORWARD-REVERSE VALVE	X		3	8	12	17	29	0	0	0	0
M1	10	51	2 REPLACE	PRESSURE FLUID FILTER	X		3	8	17	29	0	0	0	0	0
M1	10	51	3 REPAIR	FORWARD-REVERSE VALVE	X		3	9	17	29	0	0	0	0	0
M1	10	51	3 REPAIR	PRESSURE FLUID FILTER	X		3	9	17	29	0	0	0	0	0
M1	10	51	4 REPLACE	DIRECTIONAL VALVE	X		3	8	12	17	0	0	0	0	0
M1	10	51	5 REPAIR	DIRECTIONAL VALVE	X		3	9	17	29	0	0	0	0	0
M1	10	51	5 REPAIR	OIL COVER ASSY	X		3	17	29	0	0	0	0	0	0
M1	10	51	6 REPLACE	TRIM BOOST VALVE ASSY	X		3	8	17	0	0	0	0	0	0
M1	10	51	8 REPLACE	REGULATING VALVE ASSY	X		3	8	17	0	0	0	0	0	0
M1	10	51	9 REPAIR	BRANCHED CONTROL WIRING HARNESS	X		4	9	12	28	0	0	0	0	0
M1	10	51	9 SERVICE	LEFT AND RIGHT TRANSMISSION FLUID COOLER	X		8	9	12	16	18	28	0	0	0
M1	10	51	11 REPAIR	BRANCHED CONTROL WIRING HARNESS	X		4	9	12	28	0	0	0	0	0
M1	10	52	4 REPLACE	TRANSMISSION CROSS DRIVE		X	1	3	4	8	17	18	0	0	0
M1	10	52	5 REPAIR	TRANSMISSION CROSS DRIVE		X	4	8	9	12	16	17	22	29	0
M1	10	52	7 REPLACE	ACTUATOR ASSY	X		3	4	8	17	0	0	0	0	0
M1	10	52	8 REPAIR	ACTUATOR ASSY	X		17	29	0	0	0	0	0	0	0
M1	10	52	9 REPAIR	CENTER SECTION ASSY	X		3	4	7	8	22	0	0	0	0
M1	10	52	10 REPAIR	INPUT DRIVE ASSY		X	3	4	7	8	17	0	0	0	0
M1	10	52	11 REMOVE	CONVERTER DRIVE MECHANICAL HOUSING		X	1	3	17	0	0	0	0	0	0
M1	10	52	12 INSTALL	CONVERTER DRIVE MECHANICAL HOUSING		X	1	4	8	17	0	0	0	0	0
M1	10	55	2 REPAIR	LEFT AND RIGHT HAND BRAKE OUTPUT HOUSING		X	3	4	8	17	0	0	0	0	0
M1	10	55	4 REPAIR	LEFT HAND BRAKE COVER ASSY		X	3	4	8	17	22	0	0	0	0
M1	10	55	6 REPAIR	RIGHT HAND BRAKE COVER MECHANICAL HOUSING		X	3	4	8	17	22	0	0	0	0
M1	10	55	8 REPLACE	LEFT AND RIGHT HAND TRUNNION MECHANICAL HOUSING		X	3	4	8	17	0	0	0	0	0
M1	10	60	3 REPLACE	FINAL DRIVE ASSY	X		1	3	8	18	0	0	0	0	0
M1	10	60	4 REPAIR	FINAL DRIVE ASSY		X	3	4	14	17	18	0	0	0	0
M1	10	60	5 REPLACE	PACKING RETAINER	X		8	18	0	0	0	0	0	0	0
M1	10	60	6 REPAIR	PACKING RETAINER		X	8	0	0	0	0	0	0	0	0
M1	10	60	7 REPLACE	SADDLE MECHANICAL HOUSING		X	1	18	0	0	0	0	0	0	0
M1	10	60	8 REPLACE	SUN GEAR ASSY		X	1	8	18	0	0	0	0	0	0
M1	10	60	9 REPAIR	SUN GEAR ASSY		X	1	4	8	0	0	0	0	0	0
M1	10	60	10 REPLACE	PLANETARY RING GEAR ASSY		X	1	8	18	0	0	0	0	0	0
M1	10	60	11 REPAIR	PLANETARY RING GEAR ASSY		X	1	4	8	0	0	0	0	0	0
M1	10	60	12 REPLACE	FINAL CARRIER ASSY		X	1	8	18	0	0	0	0	0	0
M1	10	60	13 REPAIR	FINAL CARRIER ASSY		X	1	4	8	0	0	0	0	0	0
M1	10	60	14 REPLACE	HOUSING ASSY		X	1	8	18	0	0	0	0	0	0
M1	10	60	15 REPAIR	HOUSING ASSY		X	1	4	8	0	0	0	0	0	0
M1	10	60	16 REPLACE	SHAFT ASSY		X	1	8	18	0	0	0	0	0	0
M1	10	60	17 REPAIR	SHAFT ASSY		X	1	4	0	0	0	0	0	0	0
M1	10	60	18 REPLACE	SHAFT ASSY		X	1	8	18	0	0	0	0	0	0
M1	10	60	19 REPAIR	SHAFT ASSY		X	1	4	0	0	0	0	0	0	0
M1	10	60	20 REPLACE	PACKING RETAINER	X		1	8	18	0	0	0	0	0	0
M1	10	60	21 REPAIR	PACKING RETAINER		X	8	18	0	0	0	0	0	0	0
M1	10	71	1 SERVICE	ENGINE OIL PUMP ASSEMBLY	X		1	3	8	29	0	0	0	0	0
M1	10	71	2 REPLACE	ENGINE OIL PUMP ASSEMBLY	X		3	8	0	0	0	0	0	0	0
M1	10	72	2 REPLACE	LUBRICATING OIL TANK	X		3	8	29	0	0	0	0	0	0
M1	10	72	3 REPAIR	LUBRICATING OIL TANK	X	X	18	28	29	0	0	0	0	0	0
M1	10	72	5 REPAIR	FILLER OPENING CAP	X		28	29	0	0	0	0	0	0	0
M1	10	73	2 REPAIR	LUBRICATING COOLER	X		3	28	29	30	0	0	0	0	0
M1	30	10	3 REPAIR	SOLID RUBBER WHEEL	X		1	14	30	0	0	0	0	0	0

M1	30	31	3 REPAIR	TRACK ASSY	X			1	4	14	30	0	0	0	0	0
M1	30	31	6 REPAIR	TRACK SHOE ASSY	X			4	14	0	0	0	0	0	0	0
M1	30	32	3 REPLACE	SUPPORT ROLLER ASSY	X			18	0	0	0	0	0	0	0	0
M1	30	32	4 REPAIR	SUPPORT ROLLER ASSY	X			1	4	7	14	0	0	0	0	0
M1	30	32	5 REPLACE	TRACK SUPPORT ROLLER WHEEL ASSY	X			18	0	0	0	0	0	0	0	0
M1	30	32	6 REPAIR	TRACK SUPPORT ROLLER WHEEL ASSY	X			1	4	7	14	0	0	0	0	0
M1	30	33	4 REPAIR	HUB AND ARM ASSY	X			1	4	7	14	0	0	0	0	0
M1	30	33	6 REPAIR	WHEEL HUB ASSY	X			1	4	7	14	0	0	0	0	0
M1	30	33	7 REPLACE	PIVOT ARM ASSY	X			18	0	0	0	0	0	0	0	0
M1	30	33	8 REPAIR	PIVOT ARM ASSY	X			1	4	7	14	0	0	0	0	0
M1	30	33	10 TEST	LEFT AND RIGHT TRACK ADJUSTING LINK	X			18	0	0	0	0	0	0	0	0
M1	30	34	2 REPLACE	TRACK DRIVE SPROCKET WHEEL	X			18	0	0	0	0	0	0	0	0
M1	30	40	6 REPAIR	SHOCK ABSORBER HOUSING	X			3	4	7	14	0	0	0	0	0
M1	30	40	9 REPLACE	HUB AND ARM ASSY (POSITION 1)	X			8	14	0	0	0	0	0	0	0
M1	30	40	10 REPAIR	HUB AND ARM ASSY (POSITION 1)	X			1	4	7	14	0	0	0	0	0
M1	30	40	13 REPLACE	HUB AND ARM ASSY (POSITIONS 2 AND 7)	X			8	14	0	0	0	0	0	0	0
M1	30	40	14 REPAIR	HUB AND ARM ASSY (POSITIONS 2 AND 7)	X			1	4	7	14	0	0	0	0	0
M1	30	40	15 REPLACE	PIVOT ARM ASSY (POSITION 1)	X			8	14	0	0	0	0	0	0	0
M1	30	40	16 REPAIR	PIVOT ARM ASSY (POSITION 1)	X			1	4	7	14	0	0	0	0	0
M1	30	40	17 REPLACE	PIVOT ARM ASSY (POSITIONS 2 AND 7)	X			8	14	0	0	0	0	0	0	0
M1	30	40	18 REPAIR	PIVOT ARM ASSY (POSITIONS 2 AND 7)	X			1	4	7	14	0	0	0	0	0
M1	30	40	19 REPLACE	RETAINER ASSY (POSITIONS 1,2 AND 7)	X			8	14	0	0	0	0	0	0	0
M1	30	40	20 REPAIR	RETAINER ASSY (POSITIONS 1,2 AND 7)	X			4	14	0	0	0	0	0	0	0
M1	30	40	23 REPLACE	HUB AND ARM ASSEMBLY (POSITIONS 3-6)	X			8	14	0	0	0	0	0	0	0
M1	30	40	24 REPAIR	HUB AND ARM ASSEMBLY (POSITIONS 3-6)	X			1	4	7	14	0	0	0	0	0
M1	30	40	25 REPLACE	PIVOT ARM ASSY (POSITIONS 3-6)	X			8	14	0	0	0	0	0	0	0
M1	30	40	26 REPAIR	PIVOT ARM ASSY (POSITIONS 3-6)	X			1	4	7	14	0	0	0	0	0
M1	30	40	27 REPLACE	WHEEL HUB ASSY	X			8	14	0	0	0	0	0	0	0
M1	30	40	28 REPAIR	WHEEL HUB ASSY	X			1	4	7	14	0	0	0	0	0
M1	40	10	2 REPLACE	THROTTLE STEERING ASSY	X			4	16	24	0	0	0	0	0	0
M1	40	10	3 REPAIR	THROTTLE STEERING ASSY	X			9	16	28	0	0	0	0	0	0
M1	40	10	5 REPAIR	SHIFT CONTROL ASSY	X			9	28	0	0	0	0	0	0	0
M1	60	20	4 REPAIR	POPPET VALVE ASSY	X			0	0	0	0	0	0	0	0	0
M1	60	40	4 REPAIR	AMMUNITION RACK ASSEMBLY	X			1	4	7	8	0	0	0	0	0
M1	60	50	6 REPAIR	TANK PERISCOPE	X			8	0	0	0	0	0	0	0	0
M1	60	50	9 REPAIR	LOADER'S/DRIVER'S UNITY PERISCOPE	X			8	0	0	0	0	0	0	0	0
M1	60	50	12 REPAIR	NIGHT VISION VIEWER	X			9	28	0	0	0	0	0	0	0
M1	80	22	2 REPAIR	RESERVOIR SUPPORT	X			20	0	0	0	0	0	0	0	0
M1	80	23	2 REPAIR	HYDRAULIC RESERVOIR	X			3	4	8	29	0	0	0	0	0
M1	80	23	5 REPAIR	HYDRAULIC MANIFOLD	X			3	4	28	0	0	0	0	0	0
M1	80	40	5 REPAIR	VALVE AND BOTTLE ASSEMBLY	X			4	28	29	0	0	0	0	0	0
M1	80	40	8 REPAIR	FIRE STRAP ASSEMBLY	X			1	0	0	0	0	0	0	0	0
M1	80	40	11 REPAIR	PLUG AND PIN ASSEMBLY	X	X		1	0	0	0	0	0	0	0	0
M1	80	40	13 REPAIR	DIRECT LINEAR VALVE		X		1	0	0	0	0	0	0	0	0
M1	80	40	14 REPAIR	UPPER HOUSING VALVE	X			1	0	0	0	0	0	0	0	0
M1	80	50	4 REPAIR	NBC EQUIPMENT			X	1	4	8	0	0	0	0	0	0

M1	80 51	6 REPAIR	ELECTRICAL AIR HEATER		X	4	28	0	0	0	0	0	0	0
M1	80 60	3 REPAIR	BATTERY BOX ECU	X		28	0	0	0	0	0	0	0	0
M1	80 60	5 REPAIR	BATTERY PACK	X		10	0	0	0	0	0	0	0	C

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
M88	10	0	5	REPLACE	POWER PLANT		X		X		X	X	3	4	8	17	24	26	0	0	0
M88	10	0	6	REPAIR	POWER PLANT		X		X		X	X	3	4	6	7	8	17	20	23	26
M88	10	10	4	REPLACE	DIESEL ENGINE				X				4	8	26	0	0	0	0	0	0
M88	10	10	5	REPAIR	DIESEL ENGINE				X				3	4	6	8	23	26	29	0	0
M88	10	21	2	REPLACE	FUEL INJECTION PUMP			X	X				4	8	12	26	29	0	0	0	0
M88	10	21	4	REPLACE	FUEL INJECTION LINES			X	X				3	4	8	29	0	0	0	0	0
M88	10	21	8	REPLACE	FUEL INJECTOR NOZZLE AND HOLDER ASSY			X	X				3	8	29	0	0	0	0	0	0
M88	10	22	8	ADJUST	ENGINE FUEL PUMP			X					3	4	8	29	0	0	0	0	0
M88	10	22	9	REPLACE	ENGINE FUEL PUMP		X		X		X	X	3	4	8	29	0	0	0	0	0
M88	10	22	10	REPAIR	ENGINE FUEL PUMP			X					1	4	8	26	29	0	0	0	0
M88	10	22	12	REPLACE	FUEL TANK FUEL PUMP		X		X		X	X	3	4	8	29	0	0	0	0	0
M88	10	22	16	REPLACE	PURGE PUMP			X					3	8	29	0	0	0	0	0	0
M88	10	22	17	REPLACE	FLEXIBLE SHAFT COUPLING				X				3	8	0	0	0	0	0	0	0
M88	10	22	19	OVERHAUL	FLEXIBLE SHAFT COUPLING				X				3	8	0	0	0	0	0	0	0
M88	10	24	2	REPLACE	DIESEL TURBOSUPERCHARGER				X				1	8	18	23	26	29	0	0	0
M88	10	25	4	REPAIR	FUEL TANK		X		X	X	X	X	1	3	8	29	30	0	0	0	0
M88	10	25	9	REPLACE	LEFT REAR FUEL TANK				X				3	4	8	29	0	0	0	0	0
M88	10	25	10	REPAIR	LEFT REAR FUEL TANK				X				1	3	8	29	30	0	0	0	0
M88	10	28	3	REPLACE	ACCELERATOR AND THROTTLE CONTROLS AND LINKAGE		X		X		X	X	1	26	0	0	0	0	0	0	0
M88	10	30	3	REPAIR	ENGINE COOLING FAN AND MANIFOLD SHROUD		X		X		X	X	1	26	0	0	0	0	0	0	0
M88	10	30	8	REPAIR	FAN TOWER ASSY		X		X		X	X	1	4	8	26	0	0	0	0	0
M88	10	41	3	REPLACE	ENGINE ACCESSORY GENERATOR		X		X		X	X	9	11	12	0	0	0	0	0	0
M88	10	41	8	REPLACE	INTAKE TUBES		X		X		X	X	9	11	0	0	0	0	0	0	0
M88	10	41	9	TEST	GENERATOR REGULATOR		X		X		X	X	4	9	10	11	12	13	0	0	0
M88	10	41	10	REPLACE	GENERATOR REGULATOR		X		X		X	X	9	11	12	0	0	0	0	0	0
M88	10	42	3	REPLACE	STARTING MOTOR		X		X		X	X	4	9	11	12	0	0	0	0	0
M88	10	42	4	REPAIR	STARTING MOTOR		X		X		X	X	4	9	11	12	18	28	0	0	0
M88	10	42	12	REPLACE	STARTER RELAY SOLENOID		X		X		X	X	9	11	12	28	0	0	0	0	0
M88	10	42	14	REPLACE	RELAY HOUSING ASSY		X		X		X	X	9	11	12	28	0	0	0	0	0
M88	10	44	2	REPLACE	WARNING SWITCHES		X	X	X		X	X	9	11	12	28	0	0	0	0	0
M88	10	44	3	INSPECT	SENDING UNITS		X	X	X		X	X	9	10	12	13	0	0	0	0	0
M88	10	44	8	REPLACE	PROT SYS LOW VOLTAGE RELAY SOLENOID		X		X		X	X	9	11	12	0	0	0	0	0	0
M88	10	46	3	REPLACE	HULL WIRING HARNESS ASSEMBLIES			X					9	11	12	28	0	0	0	0	0
M88	10	46	4	REPAIR	HULL WIRING HARNESS ASSEMBLIES			X					4	9	12	0	0	0	0	0	0
M88	10	46	6	REPLACE	BILGE PUMP LEAD RELAY WIRING HARNESS			X					9	11	12	28	0	0	0	0	0
M88	10	46	9	REPLACE	BILGE PUMP CKT BKR-TO-SWITCH PANEL LEAD			X					9	11	12	28	0	0	0	0	0
M88	10	46	13	REPLACE	ACCESSORIES CABLE ASSY			X					9	11	12	28	0	0	0	0	0
M88	10	46	17	REPLACE	ENGINE ELECTRICAL INSTALLATION			X					9	11	12	0	0	0	0	0	0
M88	10	47	1	REPLACE	APU CONTROL BOX			X					4	9	11	12	0	0	0	0	0
M88	10	51	1	INSPECT	MAIN OIL FILTER ASSY		X		X		X	X	0	0	0	0	0	0	0	0	0
M88	10	51	2	SERVICE	MAIN OIL FILTER ASSY		X		X		X	X	0	0	0	0	0	0	0	0	0
M88	10	51	3	REPLACE	MAIN OIL FILTER ASSY				X				0	0	0	0	0	0	0	0	0
M88	10	51	5	REPLACE	OIL BREATHER TUBE ASSY				X				3	8	29	0	0	0	0	0	0
M88	10	51	7	REPAIR	OUTPUT OIL PUMP ASSY				X				1	4	8	26	29	0	0	0	0
M88	10	51	9	REPLACE	LUBE AND CONVERTER REGULATOR COOLER BYPASS				X				3	8	17	29	0	0	0	0	0
M88	10	52	1	INSPECT	CENTER SECTION CROSS DRIVE TRANS ASSY		X		X		X	X	3	13	17	18	20	21	24	29	0

M88 10 52	2 TEST	CENTER SECTION CROSS DRIVE TRANS ASSY	X	X	X	X	4	13	17	18	20	21	24	0	0
M88 10 52	3 REPLACE	CENTER SECTION CROSS DRIVE TRANS ASSY		X			3	8	17	18	20	29	0	0	0
M88 10 52	4 ADJUST	CENTER SECTION CROSS DRIVE TRANS ASSY	X	X	X	X	4	17	18	20	0	0	0	0	0
M88 10 52	5 SERVICE	CENTER SECTION CROSS DRIVE TRANS ASSY	X	X	X	X	4	17	18	20	24	0	0	0	0
M88 10 54	1 ADJUST	TRANSMISSION LINKAGE	X	X	X	X	16	17	0	0	0	0	0	0	0
M88 10 54	2 REPLACE	TRANSMISSION LINKAGE	X	X	X	X	16	17	0	0	0	0	0	0	0
M88 10 54	3 REPLACE	TRANSMISSION SHIFTING CONTROL ASSY	X	X	X	X	16	17	0	0	0	0	0	0	0
M88 10 55	1 REPLACE	TRANSMISSION BRAKES		X			16	17	22	0	0	0	0	0	0
M88 10 57	1 TEST	MAIN CONTROL INHIBITOR VALVE	X	X	X	X	4	13	17	26	29	0	0	0	0
M88 10 57	2 TEST	STEERING CONTROL VALVE	X	X	X	X	4	13	16	17	26	29	0	0	0
M88 10 57	3 REPLACE	STEERING CONTROL VALVE		X			3	4	8	16	29	0	0	0	0
M88 10 57	4 REPAIR	STEERING CONTROL VALVE		X			4	8	14	16	29	0	0	0	0
M88 10 57	5 TEST	FLUID PRESSURE STEERING REGULATING VALVE	X	X	X	X	4	13	16	0	0	0	0	0	0
M88 10 57	6 REPLACE	FLUID PRESSURE STEERING REGULATING VALVE		X			4	16	0	0	0	0	0	0	0
M88 10 60	1 ADJUST	OUTPUT REDUCTION ASSY	X	X	X	X	1	18	22	0	0	0	0	0	0
M88 10 60	2 REPLACE	OUTPUT REDUCTION ASSY	X	X	X	X	3	4	8	18	22	0	0	0	0
M88 10 60	3 REPAIR	OUTPUT REDUCTION ASSY		X			1	3	4	14	17	18	29	0	0
M88 10 60	4 REPLACE	OUTPUT REDUCTION SHAFT STUDS		X			4	14	18	0	0	0	0	0	0
M88 10 90	8 REPAIR	POWER TAKEOFF DRIVE ASSY		X			1	3	4	17	18	21	26	29	0
M88 30 33	2 INSPECT	ARM, ROADWHEEL ASSY	X	X	X	X	3	13	18	0	0	0	0	0	0
M88 30 33	3 REPLACE	ARM, ROADWHEEL ASSY	X	X	X	X	3	18	0	0	0	0	0	0	0
M88 30 33	5 ADJUST	ARM, ROADWHEEL ASSY	X	X	X	X	3	18	0	0	0	0	0	0	0
M88 30 40	2 REPLACE	BUMPER ASSY	X	X	X	X	14	0	0	0	0	0	0	0	0
M88 30 50	4 REPLACE	BRAKE CONTROLS AND LINKAGES	X	X	X	X	22	0	0	0	0	0	0	0	0
M88 40 10	4 REPLACE	STEERING AND SHIFTING CONTROLS	X	X	X	X	16	17	0	0	0	0	0	0	0
M88 70 0	5 REPAIR	MAIN WINCH ASSY		X			1	3	4	8	20	26	0	0	0
M88 70 0	8 REPAIR	HOIST WINCH ASSY		X			1	3	4	8	20	26	0	0	0
M88 70 0	19 REPLACE	MAIN AND HOIST WINCH BRAKE CYLINDER		X			22	0	0	0	0	0	0	0	0
M88 70 0	20 REPLACE	HYDRAULIC WINCH MOTOR		X			20	0	0	0	0	0	0	0	0
M88 70 0	21 REPAIR	HYDRAULIC WINCH MOTOR		X			1	4	8	20	29	0	0	0	0
M88 70 0	22 REPLACE	HOIST WINCH MOTOR VALVE		X			20	0	0	0	0	0	0	0	0
M88 70 0	23 REPAIR	HOIST WINCH MOTOR VALVE		X			1	4	8	20	29	0	0	0	0
M88 70 0	24 ADJUST	VALVE ACTUATING ARM CAM FOLLOWER	X	X	X	X	20	0	0	0	0	0	0	0	0
M88 70 0	25 REPLACE	VALVE ACTUATING ARM CAM FOLLOWER		X			20	0	0	0	0	0	0	0	0
M88 70 0	35 TEST	MECHANICAL TRANSMISSION ASSY	X	X	X	X	4	13	0	0	0	0	0	0	0
M88 70 0	36 REPLACE	MECHANICAL TRANSMISSION ASSY		X			8	0	0	0	0	0	0	0	0
M88 70 0	37 REPAIR	MECHANICAL TRANSMISSION ASSY		X			1	3	4	8	20	0	0	0	0
M88 70 0	39 REPLACE	TRANSMISSION OIL COOLER ASSY		X			8	0	0	0	0	0	0	0	0
M88 80 20	1 SERVICE	OIL FILTER	X	X	X	X	0	0	0	0	0	0	0	0	0
M88 80 20	2 REPLACE	OIL FILTER		X			0	0	0	0	0	0	0	0	0
M88 80 20	3 REPLACE	HYDRAULIC TANK ASSY		X			8	20	0	0	0	0	0	0	0
M88 80 20	5 REPLACE	HYDRAULIC PUMP ASSY		X			8	20	0	0	0	0	0	0	0
M88 80 20	6 REPAIR	HYDRAULIC PUMP ASSY		X			1	3	4	8	20	29	0	0	0
M88 80 20	7 INSPECT	AUXILLIARY POWER UNIT ASSY	X	X	X	X	13	0	0	0	0	0	0	0	0
M88 80 20	8 TEST	AUXILLIARY POWER UNIT ASSY	X	X	X	X	4	13	0	0	0	0	0	0	0
M88 80 20	13 REPLACE	DIESEL ENGINE ASSY		X			26	0	0	0	0	0	0	0	0
M88 80 20	14 REPAIR	DIESEL ENGINE ASSY		X			1	3	5	8	23	26	0	0	0
M88 80 20	15 INSPECT	DIESEL ENGINE ASSY OIL FILTER	X	X	X	X	0	0	0	0	0	0	0	0	0

M88 80 20	16	SERVICE	DIESEL ENGINE ASSY OIL FILTER	X		X	X	X	0	0	0	0	0	0	0	0	0
M88 80 20	17	REPLACE	DIESEL ENGINE ASSY OIL FILTER	X		X	X	X	0	0	0	0	0	0	0	0	0
M88 80 20	18	INSPECT	OIL COOLER ASSY			X			13	29	0	0	0	0	0	0	0
M88 80 20	19	SERVICE	OIL COOLER ASSY			X			29	0	0	0	0	0	0	0	0
M88 80 20	20	REPLACE	OIL COOLER ASSY			X			29	0	0	0	0	0	0	0	0
M88 80 20	22	INSPECT	FUEL INJECTION PUMP ASSY		X	X			3	8	9	10	13	29	0	0	0
M88 80 20	23	ADJUST	FUEL INJECTION PUMP ASSY		X	X			29	0	0	0	0	0	0	0	0
M88 80 20	24	REPLACE	FUEL INJECTION PUMP ASSY			X			8	29	0	0	0	0	0	0	0
M88 80 20	26	SERVICE	FUEL TRANSFER PUMP ASSY			X			29	0	0	0	0	0	0	0	0
M88 80 20	27	REPLACE	FUEL TRANSFER PUMP ASSY			X			29	0	0	0	0	0	0	0	0
M88 80 20	29	INSPECT	FUEL NOZZLE AND HOLDER ASSY		X	X			29	0	0	0	0	0	0	0	0
M88 80 20	30	REPLACE	FUEL NOZZLE AND HOLDER ASSY		X	X			29	0	0	0	0	0	0	0	0
M88 80 20	31	REPAIR	FUEL NOZZLE AND HOLDER ASSY		X	X			1	29	0	0	0	0	0	0	0
M88 10 41	42	TEST	GENERATOR/STARTER (COMBINATION)			X			4	10	11	12	0	0	0	0	0
M88 10 41	43	REPLACE	GENERATOR/STARTER (COMBINATION)			X			8	11	12	0	0	0	0	0	0
M88 80 20	45	REPLACE	APU ELECTRIC WIRING		X	X			8	9	12	0	0	0	0	0	0